

Popular Science

FOUNDED MONTHLY 1872

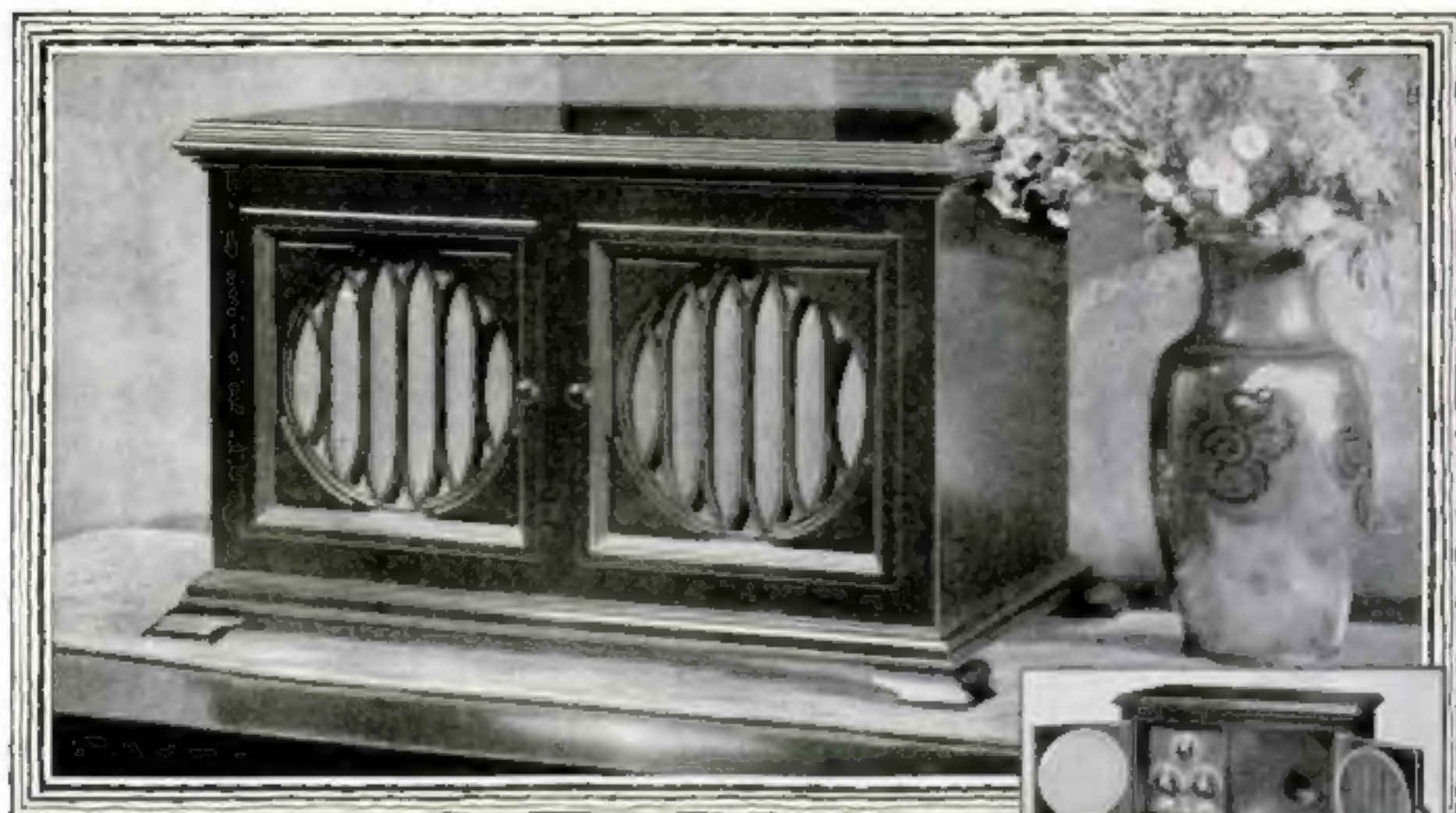


See Page 38

DECEMBER

Most Wonderfully Illustrated Magazine in the World

25 CENTS



Opera from the Stage Football from the Field with a **Radiola IV**

Radiola IV.

A long distance receiver made with the perfection for which RCA is famous. Mahogany finished cabinet; with four tubes (one spare); head phones and plug; silk covered tones. \$275
At the nearest radio or electrical dealer.



This symbol of
quality is your
protection

Send for the free booklet
that describes every Radiola

RADIO CORPORATION OF AMERICA
Dept. 2060. (Address office nearest you.)
Please send me your free Radio Booklet.

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Tune in—then shut the doors. Sit back and listen to the music that's being sung a hundred miles away. Dance to fine orchestras playing in the big cities. Call in the crowd when the big game is on. It's real!

Enclosed in its fine cabinet—with all its workings hidden—with its batteries inside—and its loudspeaker built-in—Radiola IV is a great achievement. Simple, powerful, dependable. Not only by virtue of its radio construction, but by the perfection of its workmanship and finish. It gets distance—gets it simply and clearly, at the turn of a knob. And fits with dignity into the finest living room.

Tune in—the air is crowded! Fun—music—education—big, exciting events. Listen in on them all with a Radiola IV.

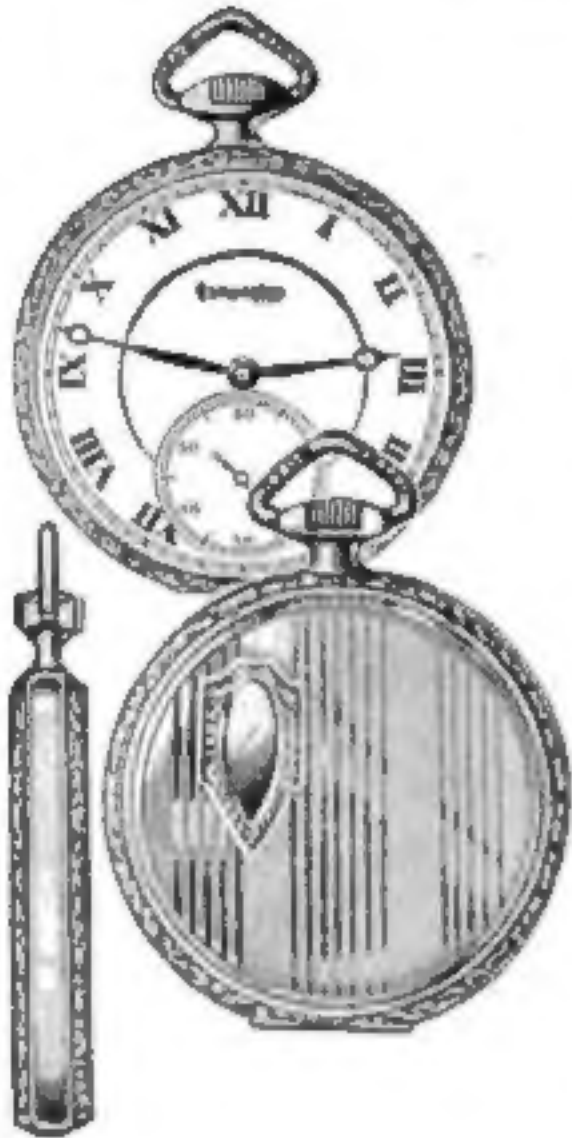
Radio Corporation of America

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Radiola

21 Jewel Burlington



Adjusted to the Second
Adjusted to Temperature
Adjusted to Isochronism
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21 Ruby and Sapphire Jewels
25 Year Gold Strata Case
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New Ideas in Thin Cases

Only \$1⁰⁰ Down

Only One Dollar Down will buy this masterpiece of watch manufacture. The balance you are allowed to pay in small, easy, monthly payments. The Burlington—a 21-Jewel Watch—is sold to you at a price much lower than that of other high-grade watches. Besides, you

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Latest designs in Watch Cases beautifully illustrated in our booklet. Send for FREE Copy.

have the selection of the finest thin model designs and latest styles in watch cases. Don't delay! Write for the FREE Watch Book and our SPECIAL OFFER today.

Write *While This Special Offer Lasts*

Get the Burlington Watch Book by sending this coupon. Find out about this great special offer which is being made for only a limited time. You will know a great deal more about watch buying when you read this book. You will be able to "steer clear" of the over-priced watches which are no better. Remember, the Burlington is sent to you for only One Dollar down, balance in small monthly payments. Send the coupon for watch book and our special offer TODAY.

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Dept. 13-69, 19th Street and Marshall Blvd., Chicago
Canadian Address: 62 Albert St., Winnipeg, Manitoba

Burlington Watch Company

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Canadian Address: 62 Albert St., Winnipeg, Manitoba

Please send me (without obligations and prepaid) your free book on watches with full explanation of your \$1.00 down offer on the Burlington Watch.

Name _____

Address _____

POPULAR SCIENCE MONTHLY

Most Wonderfully Illustrated Magazine in the World

DECEMBER, 1923; Vol. 103, No. 6
25 cents a Copy; \$2.50 a Year



Published in New York City at
225 West Thirty-ninth Street

A YOUNG fellow in our town used to have an exaggerated opinion of his own importance. He talked a lot and said little. Now he thinks a lot and talks little. He has been reading and thinking of recent revelations of science in the world of the infinitely large and the infinitely small. Such thought is good to reduce the ego of mortals.

* *

CONSIDER our stellar system, the Milky Way. It consists of millions of stars, alongside of which our sun, a giant compared to the earth, is but a dwarf. Antares, the largest star yet measured, larger even than Betelgeuse, has a diameter of 400,000,000 miles. Our world, with its diameter of 8000 miles, compares with it about as does an anthill with the Woolworth Building.

* *

YET in the depths of space are many other systems, perhaps larger than ours. If by some chance the earth should collide with one of these tremendous celestial bodies, it would disappear as quickly as a snowflake in a blast furnace. Romance is there—the romance of the infinitely big. And there is mystery, too—the mystery of the unknown and the intangible.

* *

ROMANTIC also is the atom. Its wonders are invisibly small. Each atom is a miniature solar sys-

tem, so small that no human eye has ever seen it. Electrons, concentrated electrical charges, revolve with a velocity of 93,000 miles a second about a nucleus as the planets revolve about our sun. One thousand million million million of these electrons equal the weight of a single cigarette paper. A scientist explained that if one imagined an atom having a diameter of a

mile, an electron moving in it would be as large as a dining-table and the nucleus the size of a pea.

* *

TEAR the atom apart and you will find it veritably alive with a prodigious force. It has been pointed out that the electronic energy in a glass of water is sufficient to propel the *Leviathan* to Europe and back at top speed. Science, inseparable twin of Romance, is striving to harness this tremendous power. One day it will do the work of the world.

* *

ON THIS planet, where a thousand miles is a great distance and the head of a pin is small, it is difficult to comprehend the infinite. We are in something of the position of moths, attracted by an arc light, striving to understand electricity. But stories of these wonders serve to reduce the ego. They did that for the young man in our town. And they help men understand the promises of science for the future of the world.

In Next Month's Issue

The Story of the Mind—First article in an unusually helpful psychological series by James J. Walsh, M. D., Ph. D., famous American surgeon and psychologist.

Harnessing the River Jordan—How Science, in its restoration of the Holy Land, today is carrying out ancient Biblical prophecies.

Jack Binns on Radio—An understandable and usable article on the heterodyne receiver by the foremost writer on radio in America.

Your New Car—Mechanical improvements in the 1924 automobile. A practical article that will help you make your selection.

And 200 other fascinating articles and pictures

See Special Christmas Offer on page 88

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription in United States, 40 payments, and Canada, \$2.50; foreign countries, \$3. Entered as second-class matter Dec. 28, 1913, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1923, by the Modern Publishing Co. The contents of this magazine must not be reprinted without permission. H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

If You Want Bigger Pay *Make This* **FREE TEST**

There's a sure way to increase your earning power. And here is such an opportunity. Look into it—you may recognize it as your one chance to earn the biggest money of your life.



ARE you ready for a shock? Then, let me tell you that if you have average intelligence and can read and write, there is a quick and easy way for you to double or triple your present salary—to earn enough money to satisfy any average ambition. And after reading this offer, if you do not quickly make more money, you have no one to blame but yourself.

Don't take my word for it. By a simple free test—one you can make in the privacy of your home—you will know that every word I say is true—or otherwise. The test does not obligate you or cost you one penny. But make it! Then judge for yourself. It has proved to be THE opportunity for thousands. They have found the way to bigger pay—are now earning from five to twenty times as much as formerly. And the beauty of it is they enjoy every minute in the day's work. They are their own bosses.

A Field of Unlimited Opportunities

The thousands who have made this test before you, and who are now making the money you would like to make, are now salesmen. Ninety-five per cent once thought they were not "cut out for selling," that salesmen were "born" and not made. They found it was a fallacy that had kept them in the rut. They discovered that any one with proper training can sell, and they are making from \$5,000 to \$10,000 a year because they had the vision to recognize opportunity.

Are trained salesmen in demand? Look at the affidavit on this page.

Thousands Have Proved It

For instance, Ellis Sumner Cook, 20 E. Jackson Blvd., Chicago, left a \$25 a week job and last year made \$9,000! H. D. Miller, another Chicago boy, was making \$100 a month as a stenographer in July, 1922. In September, 3 months later, he was making \$100 a week as a salesman. W. P. Clenny of Kansas City, Mo., stepped from a \$150 a month clerkship into a selling job at \$500 a month. He is making \$850 a month now.

M. V. Stephens of Albany, Ky., was making \$25 a week. He took up this training and now makes five times that much. J. H. Cash of Atlanta, Ga., exchanged his \$75 a month job for one which pays him \$500 a month. O. H. Malfort of Hartford, Conn., stepped into a \$10,000 position as a SALES MANAGER—so thorough is this training. All these successes are due to this easy, fascinating and rapid way to master certain invincible secrets of selling.

These men were formerly clerks, bookkeepers, factory workers, farm hands, mechanics, machinists, chauffeurs, firemen, motormen, conductors, etc. Their success proves that previous experience or training has nothing to do with success in the selling field. It proves that any man who wants to, and who is willing to put in a few hours of spare time each week, can quickly get a selling position and make big money. And they started with this free test.

Why don't you make this free test and prove, to your own satisfaction, that a bigger salary is easy to get? The test is contained in a free book, "Modern Salesmanship," which we will gladly send you without obligation. After reading the

book through you will ask yourself the questions it brings up. The answers will show you whether you can get away from the humdrum, small-pay job for the lucrative and fascinating work of selling.

Make This Free Test At Once

Don't turn this page until you have clipped the coupon, filled it out, and sent it on its way. It may mean the turning point in your life. Write now while the impulse to succeed is upon you.

NATIONAL SALESMEN'S TRAINING ASSOCIATION
Dept. 15-W Chicago, Illinois

National Salesmen's Training Association
Dept. 15-W, Chicago, Illinois.

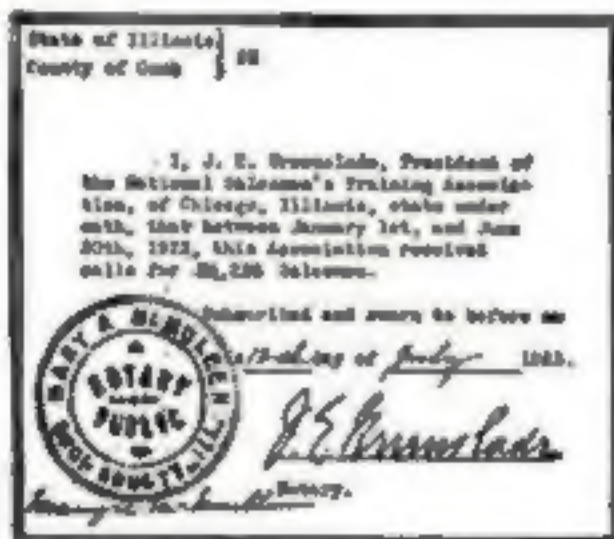
Please send me without obligation on my part, your free book, "Modern Salesmanship," which will enable me to test my ability at home, and full information about the N. S. T. A. System of Salesmanship Training and Employment Service.

Name

Address

City State

Age Occupation



See Here! You can make \$75 to \$125 a week!

BE AN AUTO EXPERT!

Keep your Job—stay home—loan me part of your spare time and I'll make you an AUTO EXPERT quick. A liking for machinery all you need. As directing Engineer of the big CHICAGO AUTO SHOPS I train you the "JOB-WAY"—no books or useless theories in my course. I show you the short-cuts, the inside methods acquired during my twenty years in training men.



B. W. COOKE, Directing Engineer

To meet the need for AUTO EXPERTS Mr. Cooke has spent more than 20 years preparing his "JOB-WAY" home training. There is no other way for you to get ALL the branches of Automotive instruction. Behind train Auto Mechanics, Cook's "JOB-WAY" training makes you an Auto EXPERT!

I GUARANTEE

to prepare you right at home to go into business for yourself where you can become INDEPENDENT. I guarantee to train you to hold down any EXPERT'S job at TOP SALARY. I guarantee to make you an EXPERT right in your own home—to give you the most practical instruction ever devised in every branch of Automotive Mechanics, Automotive Electricity, Battery, Ignition, Welding, Vulcanizing, etc. And I guarantee to refund your money if you are not entirely satisfied.

Learn at HOME!

In your spare time! Prepare to get your share of the thousand million dollars spent annually for auto upkeep. Now 15 million autos, trucks and tractors crowding the cities, highways and farms. 15,000,000 electrical systems to maintain and repair, 50,000,000 tires to replace and repair, 15 million batteries to test and service, 15 million autos, trucks and tractors to keep going.

I Train you quick the JOB-WAY!

I train you with tools, not books—with JOBS, not theories. I stay with you until you are a success! Good jobs everywhere! In garages, repair shops, service-stations, factories. As salesmen, demonstrators, electrical experts, Master Mechanics. In Battery Stations, Vulcanizing Shops, Welding Plants or in business for yourself. Salaries sky-high, easy hours, and opportunities for a business of your own all around you! Man alive! You cannot afford to hesitate a minute!

EARN

\$3000 to \$10,000 a Year!

and Boss the Job!

You will master
Auto Mechanical Work
Auto Electrical Work
Automotive Salesman-
ship
Garage and Shop Man-
agement
Automotive Production
Work
Superintendent
Battery Work
Welding Work
Service Station Work,
etc.



A Business of Your own paying \$5,000 to \$15,000 a year!

Garage Repair Work
Battery Work
Welding Work
Tire Repair Work
Auto Electrical Work
Auto Accessories Store
Tire and Battery Sales

SUCCESS COUPON

**B. W. COOKE, Directing Engineer
CHICAGO AUTO SHOPS**
Dept. 913,
1553 W. Madison St., CHICAGO

Please send me Free Book and complete information about your "Job-Way" training at home. Tell me about the opportunities today for Auto Experts. I am making this promptly to secure FREE REPAIR OUTFIT and the reduced prices and special terms you offer now. Of course, I am not obligating myself in any way.

Name.....

Address.....

City.....State.....

Mail Coupon for Free Catalog!

START NOW!

I'll help you start and help you finish. Inducements you cannot resist, RIGHT NOW to ambitious men; terms within reach of everybody! Free Employment Service to help you get the job you want at top pay! Many extras, but not one penny extra for anything. Find out how easy I have made it for you to SUCCEED thru my SUCCESS coupon. Mail it right away!

**B. W. COOKE • Directing Engineer
CHICAGO AUTO SHOPS**

Dept. 913, 1553 W. Madison St., CHICAGO



FREE! BIG \$18.50 REPAIR OUTFIT

I give you this fine \$18.50 repair outfit free, teach you how to use it and make money almost from the start of your training. Mail coupon and get full information.

MAIL COUPON TO-DAY!



Herbert Dickerson,
Warrenton, Va.,
makes \$7,500 a year



Automotive Electricity pays W. E. Pence,
Chesham, Wash., over \$9,000 a year



J. R. Morgan, Delaware, Ohio, makes \$30
to \$50 a day in business for himself

Electrical Experts Are in Big Demand I Will Train You at Home To Fill a Big Pay Job

Electricity— the World's Big Pay Field

Electricity is the field of the greatest opportunities. In all other trades and professions competition is so keen from over-crowding that only the exceptional man can get to the top.

Not so in the Electrical line. Here is a profession that is fairly bubbling with possibilities—with thousands of chances for wonderful success. We stand today on the very threshold of the real Electrical Age—an Age when everything now operated by steam or gas or horses, will be moved by Electricity. But it is an Age demanding specialists—trained men—Electrical Experts. Such men can easily earn from \$12 to \$30 a day.

Money is being poured into the Electrical industry at the rate of a billion dollars a year. Think of it—a thousand million dollars a year for electrical expansion. This means—men—jobs—opportunities.

My big book the "Vital Facts" of the electrical industry and the wonderful opportunities that await "Cooke Trained Men" tells you all about this Big Pay Field.

**Mail Coupon
for the Free
Vital Facts**

It's a shame for you to earn \$15 or \$20 or \$30 a week, when in the same six days as an Electrical Expert you can make \$70 to \$200 a week—and do it easier—not work half so hard. Why then remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a real job in the great electrical industry. I'll show you how.

Be an Electrical Expert Earn \$3,500 to \$10,000 a Year

Today even the ordinary Electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the "Electrical Expert"—who is picked out to "boss" the ordinary Electricians—to boss the Big Jobs—the jobs that pay \$3,500 to \$10,000 a Year. Get in line for one of these "Big Jobs" by enrolling now for my easily learned, quickly grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

Age or Lack of Experience No Drawback

You don't have to be a College Man; you don't have to be a High School Graduate. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need, and I will give you that training. My Course in Electricity is the most simple, thorough and successful in existence, and offers every man, regardless of age, education, or previous experience, the chance to become, in a very short time, an "Electrical Expert," able to make from \$70 to \$200 a week.

FREE Electrical Working Outfit FREE

With me, you do practical work—at home. You start right in after your first few lessons to work at your profession in the regular way. For this you need tools, and I give them to you absolutely free—a whole kit, a complete outfit, one that would cost you \$12 to \$15.

Your Satisfaction Guaranteed

So sure am I that you can learn Electricity—so sure am I that after studying with me, you, too, can get into the "big money" class in electrical work, that I will guarantee under bond to return every single penny paid me in tuition, if, when you have finished my Course, you are not satisfied it was the best investment you ever made.

Guarantee Backed by a Million Dollar Institution

Back of me in my "guarantee," stands the Chicago Engineering Works, Inc., a million dollar institution, thus assuring to every student enrolled, not only a wonderful training in Electricity, but an unsurpassed Student Service as well.

It's this Service that makes "Cooke" training different from any other training. It's this Service, plus "Cooke" Training, that makes the "Cooke" Trained Man the "Big Pay Man," everywhere.

Be a "Cooke" Trained Man and earn \$12 to \$30 a day—\$70 to \$200 a week—\$3,500 to \$10,000 a year.

Get Started Now—Mail Coupon

I want to send you my Electrical Book and Proof Lessons both Free. These cost you nothing and you'll enjoy them. Make the start today for a bright future in Electricity. Send in Coupon—NOW.

L. L. Cooke, Chief Engineer

Chicago Engineering Works
2150 Lawrence Ave., Dept. 38 Chicago

Use this Free Outfit Coupon!

L. L. COOKE, The Man Who Makes
Dept. 38 "Big Pay" Men
2150 Lawrence Ave., Chicago

Dear Sir: Send at once, Sample Lessons, your Big Book, and full particulars of your Free Outfit and Home Study Course, also the Free Radio Course—all fully prepaid without obligation on my part.

Name

Address

Occupation

The "Cooke" Trained Man is the "Big Pay" Man

Look Here!

Are you ambitious—are you looking for the way to Success? - Do you want an easy, pleasant job? Do you want to make from \$60 to \$200 a week? - Do you want to enjoy the luxuries of life?

Then Read My Offer!

I Guarantee

to train you right at home—to make you an EXPERT DRAFTSMAN quick! I guarantee to prepare you to hold down any big pay job in any Drafting Office and to refund every cent of your money if you are not satisfied with my training. I guarantee to give you my practical JOB-WAY instruction until you are actually placed in a drafting position paying at least

\$250 to \$300 a month!

I have recommended Drafting as a life-work to thousands of men during the past 20 years—I have seen them step into big-salaried positions after completing my course—I have thousands of letters to prove that my "Job-Way" instruction has made these men SUCCESSFUL DRAFTING EXPERTS—and I offer you now the same



opportunity to get into a business where there are always more jobs than Experts to fill them, where salaries are big, hours short, work pleasant.

COYNE SCHOOL OF DRAFTING

Immediately after completing the Coyne drafting course I went to work for Johnson and Company. I held my own easily with more than a hundred draftsmen and was promoted to first draftsman of value inside with a year or more of experience got much on positions that seemed perfectly simple to me.

Five months later I left Chicago to accept a position in New York at a large increase in salary. I was the person chiefly to the thorough Coyne training.

Very sincerely yours,
A. E. DUBENROFF.

BE AN EXPERT DRAFTSMAN!

Learn at Home in your spare time!

Common schooling all you need. Learn in a few months. Plenty jobs everywhere—railroads, factories, builders, Cities, Countries, States, the U. S. Government, shipyards, automotive plants, architects and dozens of other lines all need Expert Draftsmen. Salaries range from \$60 to \$200 a week. Drafting Experts are always in demand for promotion as superintendents, managers and other official positions. Below any machine, building or product can be made, a Draftsman must draw the plan. He's the key-man of industry. Executives depend on him. Not a wheel can turn without him.

\$19 Professional Drafting Outfit FREE!

The Coyne "Job-Way" teaches you Drafting with the same instruments and methods you will use as an EXPERT when employed at a big salary. In order to help you START RIGHT NOW, we offer this \$19 Outfit FREE to every Coyne student. Coupon brings complete information. Mail it immediately.

2 Books FREE!

"Drafting the Foundation of Industry" and "Learn Drafting by the 'Job-Way'". Pioneers reduced, easy terms now. Mail coupon today and take advantage of this opportunity.

Address Chief Draftsman,

COYNE SCHOOL OF DRAFTING

Dept. 915, 1-9 S. Ashland Avenue, CHICAGO, ILL.

MAIL COUPON TO-DAY!

Chief Draftsman,
Coyne School of Drafting,
Dept. 915,
1-9 S. Ashland Avenue,
Chicago, Ill.

Without obligating me in any way, please send me your two books, "Drafting, the Foundation of Industry" and "Learn Drafting by the 'Job-Way'"—all absolutely free. Also complete information of your rapid home-study Drafting course, free instruments and other features.

Name.....

St. No.....

City..... State.....

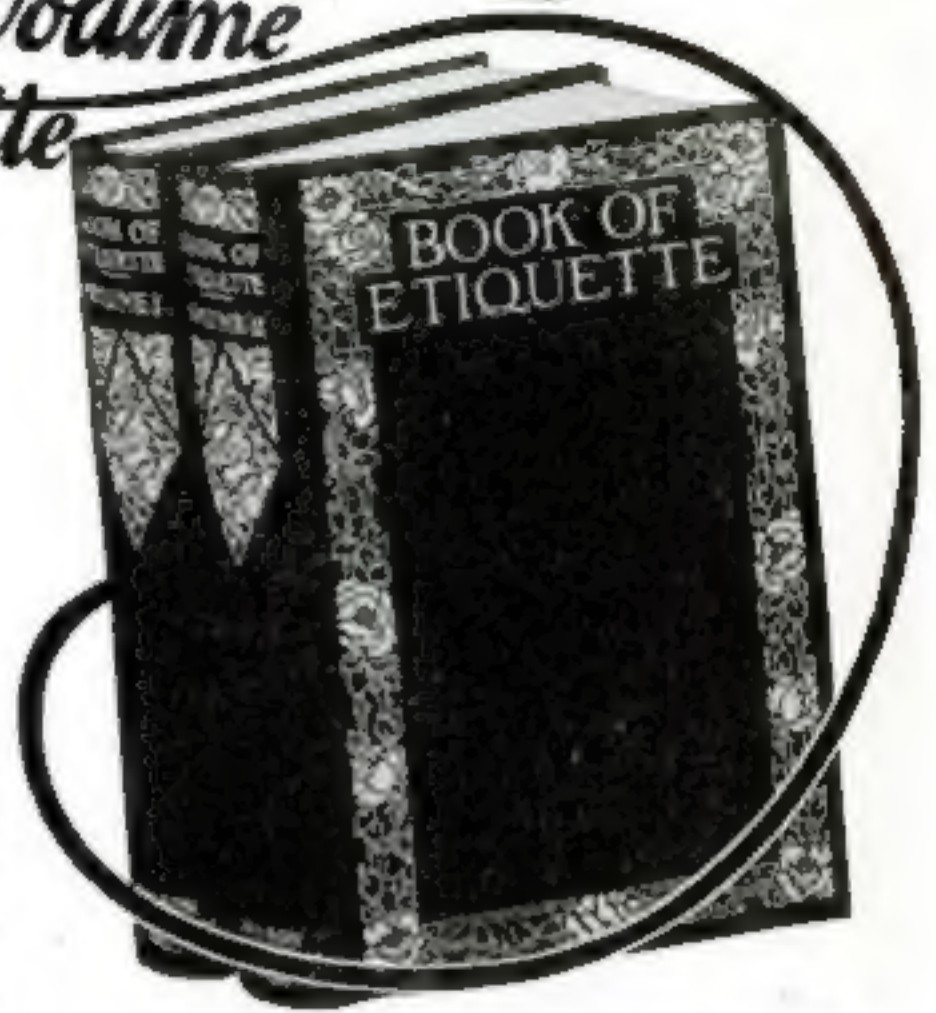


A Wonderful Bargain!

The Famous Two-Volume Book of Etiquette

500,000 Already Sold at \$3.50

NOW \$1.98
ONLY For a Very Limited Time



IF YOU are one of the 500,000 men and women who have purchased the Book of Etiquette, you will agree that it is a positive insurance against social blunders and sudden embarrassments. If you are not among those who have profited through the help of this famous set of books, you have surely heard about them and wanted them. But if you have intended to make these books your own, don't hesitate another day, for this wonderful bargain offer is made for you. If you act quickly, you can get your set of these famous books—not for \$3.50, which 500,000 people have gladly paid—but for only \$1.98 complete. And without a cent in advance!

Should She Invite Him In?

Countless little problems confront the man and woman who attend the theater, dance, dinner or reception. It is so easy to make embarrassing blunders. This couple have just returned from a dance. Although it is late, the folks are still up. Should she invite him in or say good-night at the door? Should he ask permission to go into the house? Should she ask him to call again?



Are You Ever Tongue-tied at a Party?

Have you ever been seated next to a stranger at dinner and discovered there wasn't a thing to talk about? Have you ever found yourself tongue-tied—unable to say what you wanted to say, hesitant and embarrassed instead of well-poised, at ease and CONFIDENT?

Solves Every Social Problem

The famous two-volume Book of Etiquette is unquestionably the most authoritative, complete and helpful work of its kind. It covers every phase of wedding, street, dinner, dance and theatre etiquette. It contains valuable information for the self-conscious and timid; the bachelor, business woman and country hostess. It tells you the proper thing to do, say, write and wear on any and every occasion. It is a positive insurance against the numerous embarrassments that come so unexpectedly.

Why We Are Making This Special Offer

You are probably wondering why we are making this offer—why, when 500,000 people have gladly paid \$3.50 for the Book of Etiquette, we now offer it to you for only \$1.98. Here's the answer: Due to the enormous volume of books which we publish, it is necessary to maintain a staff of high-grade, capable men and women. Right now there is a lull in the publishing business. Yet it is necessary to keep our presses running and our employees busy. In doing that we are printing more books than are required to supply the demand. Therefore, we are compelled to increase this demand by making certain inducements. That is why we are now offering the Book of Etiquette for a short time only, at practically one-half the publisher's price. You can now get your set for \$1.98—if you act quickly.

SEND NO MONEY

You need not send a cent in advance in order to take advantage of this unusual bargain. Just mail the special coupon today. When the books arrive, pay the postman only \$1.98 (plus delivery charges) and the Book of Etiquette is yours. But act NOW if you want the benefit of this offer. The response will be great and we cannot afford to maintain such a collection for anything but a short time. Therefore, we urge you to order today. You take no risk—if you are not entirely satisfied, your money will be refunded. Nelson Doubleday, Inc., Dept. 2512, Garden City, New York.

Mail This Special Coupon

NELSON DOUBLEDAY, Inc.
Dept. 2512, Garden City, N. Y.

I accept your special, limited offer. Please send me the complete two-volume Book of Etiquette, regular price \$3.50. When the books arrive, I will pay the postman only \$1.98 (plus delivery charges), with the understanding that if I am not satisfied, I may return them in 5 days and get my money back.

Name.....

Street.....City.....State.....



Money Making Opportunities for "Popular Science" Readers

AUTOMOBILES AND ACCESSORIES

PATENTS. Write for our Patent Book, List of Patents, Royalties, and "How to Obtain Patents." Includes detailed information, most model or sketch of your invention for our free opinion of its patentability. *Patent Information, Victor J. Evans & Co., 180 Ninth, Washington, D. C.*

AUTOMOBILES. Parts—Used parts for sale and out of full factory list prices. Allen, Delano, Ford, Cadillac, Chevrolet, Chrysler, Dodge, Buick, Packard, Hudson, Buick, Oldsmobile, Chevrolet, Oldsmobile, Buick, Packard and many others. Send list of parts wanted. *Maxwell Bros., 4105 Olive Street, St. Louis, Missouri.*

AUTOMOBILE OWNERS. Automobiles, accessories, and for home use. America's popular motor magazine, a complete list of motor-owning articles on repairs, maintenance, fuel, oil, tires, batteries, etc. *Automobile Digest, 350 Parker Place, Cincinnati.*

AGENTS. Extraordinary Automobile Service, "Money Making Three Ways." Thousands paid. Every day. *Automobile Digest, 350 Parker Place, Cincinnati.*

AVIATION

THE American School of Aviation announces a new correspondence course in mechanics of aviation. A complete training in practical aviation. *American School of Aviation, Dept. 1742, 300 Madison Ave., New York, N. Y.*

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How to Invent— What to Invent

and What to Do About Protecting and Selling An Invention

ALTHOUGH the fact has been universally recognized that invention is governed by a few simple, easily acquired, fundamental principles, no one ever thought of putting these principles back into the minds of the everyday inventor. In fact, it was not until Thomas A. Edison's famous statement that inventors should be taught as a science, thousands of people continued to work blindfoldedly, haphazardly to perfect their ideas.

But now anyone can learn how to invent. Fifteen famous inventors have at last given to the world the laws and principles of Inventive Science. They have shown every ambitious man and woman how to invent. They are teaching invention exactly as other people are teaching law, medicine, bookkeeping. Instead of wasting years groping blindly, instead of wasting your time in useless experiments, you learn how to complete your ideas quickly and to know when they are completed. You learn how to think so you are sure to succeed.

Everybody Invents

For a long time it was commonly believed that every invention was a matter of pure luck—the result of some happy inspiration that suddenly came, and which made haplessly rich the man who made the slightest effort or thought. But you can prove for yourself that this is not so. You can prove for yourself that invention is the result of thinking and action along definite, exact, scientific lines.

Suppose when you went home tonight you found a window rattling. Through your mind would flash, almost instinctively, a regular order of thoughts which characterize the conception and completion of every invention the world has ever known. First you would recognize a problem to be solved—the rattling of the window. Then you would think of several principles of science or mechanics which would solve your problem. You might think of the scientific fact that if you poured water on the frame the wood would swell and tighten the window. You might think of using a nail. But what you most probably would do would be to use the oldest mechanical principle known to man, the wedge.

What Invention Is

Brought down to its simplest terms, that is exactly the way every invention has been made—combining two ideas, a problem

How to develop your imagination
How to develop your ideas
How to get the facts you need for inventions
How to keep legal records of ideas
How to use scientific principles of mechanics
How to avoid wasting time on impractical inventions
How to apply for a patent
How to organize a company
How to protect your rights
How to market a patent
and hundreds of other vitally important facts which EVERY successful inventor knows and uses.

which must be solved and a fact of science which can be applied. So, although you may never have thought of it, you have been inventing all your life.



thought and action which govern the Science of Invention.

Therefore, if you want to develop your inventive ability, you must learn to think. You can learn to think by thinking. You know, that every invention is made by thinking inventively.

And you can learn to think by thinking inventively. You can learn to think by thinking inventively. You can learn to think by thinking inventively.

With every new advance, we discover new discoveries that the world is full of more problems are coming up—and more inventions are needed to solve these problems. Now as never before, are inventions wanted, and the world is waiting for the man or woman who can solve one of these problems.

For the ideas can bring you a fortune. For example, who invented the rubber tip of a pencil, has been paid hundreds of thousands of dollars for his invention. The man who invented the first typewriter, the man who conceived the idea of the "bumped" hairpin, the man who developed the metal tape measure, all have achieved success and wealth as great as that of the greatest inventors in the world.

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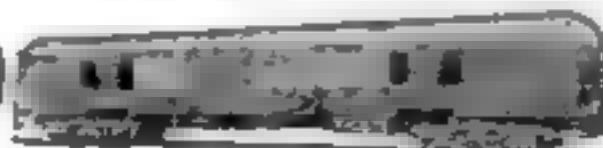
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6	1995	Paris	France
7	1996	Madrid	Spain
8	1997	Berlin	Germany
9	1998	Amsterdam	Netherlands
10	1999	Brussels	Belgium
11	2000	Stockholm	Sweden
12	2001	Helsinki	Finland
13	2002	Tampere	Finland
14	2003	Turku	Finland
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100			

Actual Results

[illegible]

The top of my head is now almost covered with grey hair and, in my next five years, but could never be.

[illegible]

NEVER restore your hair. Very likely you are skeptical. All right, I bet I can convince you. And I'll admit right here that my treatment may not help you either. For your case may be one of the three in every hundred that is absolutely hopeless. In any case, I want you to try my treatment at my risk—and if after 30 days

king a sing
a check refund
want a cent of your money
actually grow but on your head! You
course, are to be the sole judge.

Entirely New Method

My treatment is the result of 17 years of experience gained in treating thousands of cases of baldness. This included many long years which I spent in such famous centers of scientific research as Heidelberg, Berlin, Paris, Geneva, and Buenos Ayres. And my method is entirely different from anything known or used before.

There is no singing—no singing—no change of faces—no unnecessary fuss or bother of any kind. Yet results are usually noticeable even after the very few first treatments.

My treatment proves that a big percentage of baldness is caused—not by *dead* hair roots—but by *dormant* hair roots, which can now be awakened and made to grow hair again. The reason other treatments failed is because they did not penetrate to these dormant roots. To make a tree grow you would not



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William Barry, Pa.
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Panama, Pa.
Port Collins, Colo.
Calgary, Alta., Canada
Illinois Reformatory
Joliet, Ill.
House of Correction
New Haven, Conn.
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CONVICT #138, escaped from the State Penitentiary;
Name Charles Condry Age 37 Height 5 ft 8 in;
Weight, 141 pounds; Hair, light brown; Eyes, gray.

Easy enough to identify him from his photograph and
this description, you may say—but Condry took the
name of "Brown," dyed his hair, darkened his skin,
grew a mustache, put on weight and walked with a stoop.

Yet, he was captured and identified so positively that
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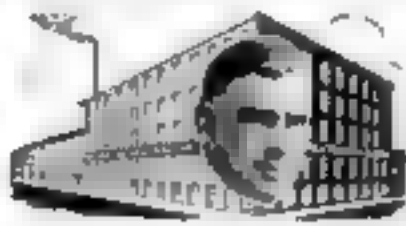
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on pages 8 to 24

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April 2

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April 10

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October 2

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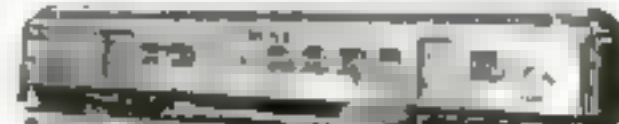
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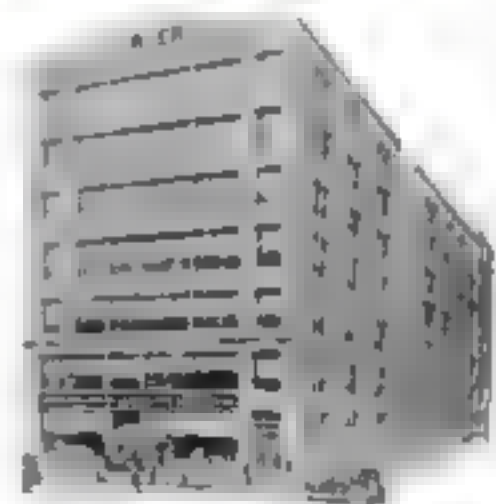
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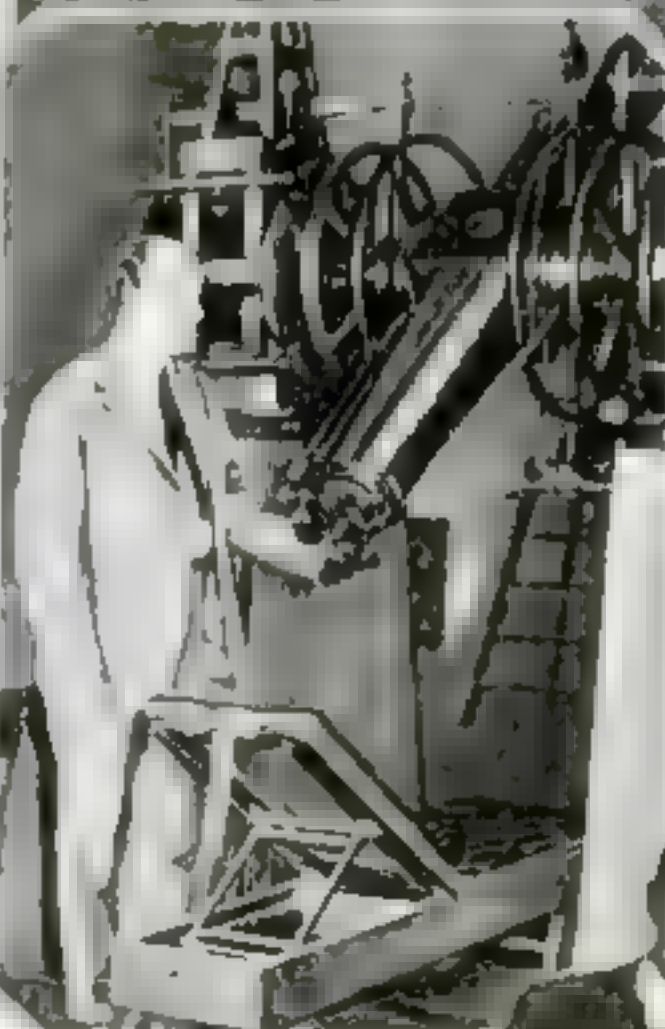


DR. CHARLES P. STEINMETZ, world famous electrical wizard. In a recent remarkable prophecy of the future, in 1923, he declared that we are in the threshold of an age that will witness a greater flowering of man's ingenuity than the 100 years through which we have just passed. He predicted that there is a coming when there will be no long back-breaking budgets and when people will work not more than four hours a day.

F. J. TURQUAND, London mining engineer, seated below, has perfected a telephone instrument that tests machinery by making it vibrate as they vibrate over the telephone. He is shown demonstrating his apparatus which, he says, is valuable also in detecting leadly chokes, lamp-room, power lines, preventing disastrous explosions.



DR. RALPH H. MCKEE, Professor of Chemical Engineering and Chemistry at Columbia University. He has developed a new method of manufacturing "starvin'" an artificial for the new remedy for diabetes discovered by Dr. M. Kohn.



PROF. J. C. HAMMOND, astronomer of the Naval Observatory, Washington, D. C., working at a six-inch transit circle with which he tests the accuracy of time. He claims to have proved that clocks do not run faster at night than in the daytime, a question much discussed by astronomers.





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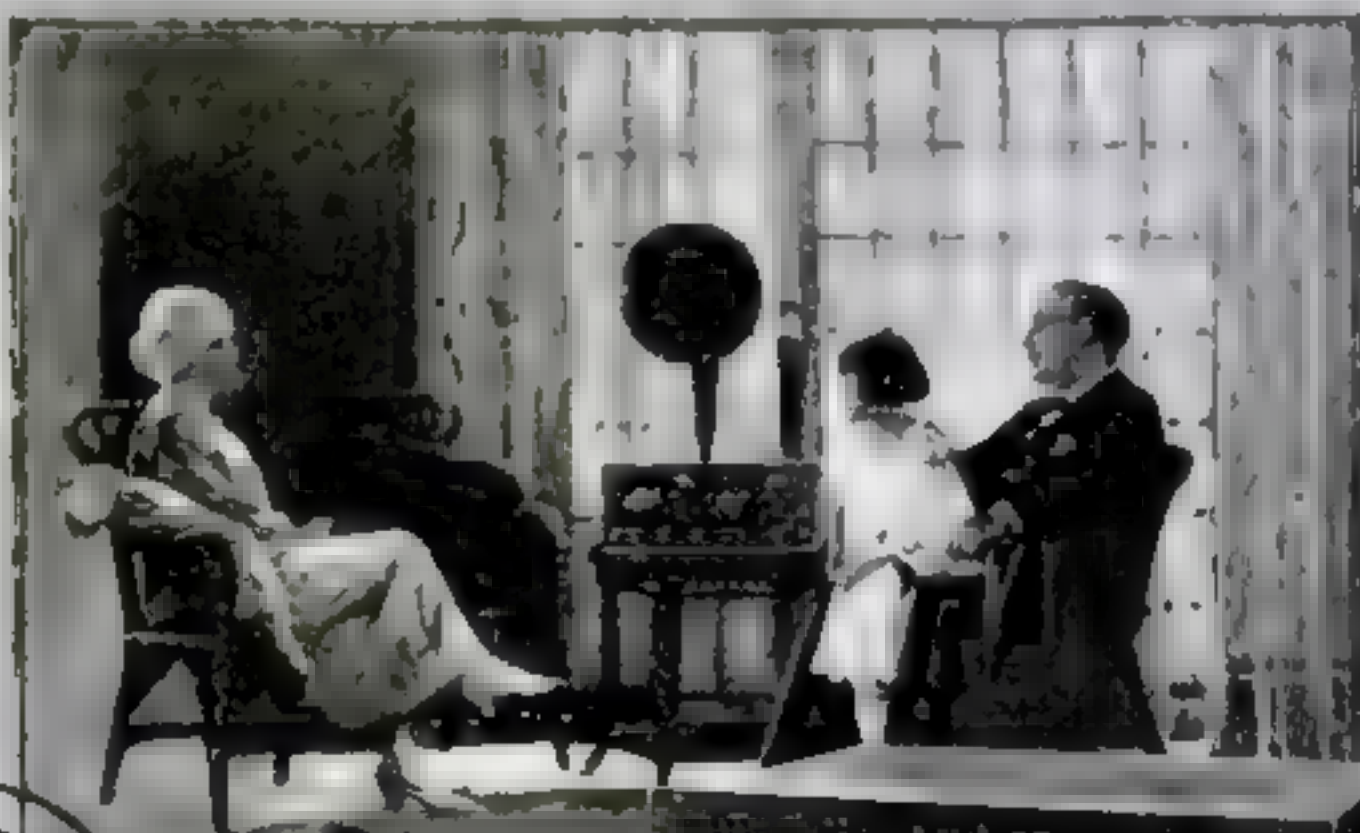
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POPULAR SCIENCE MONTHLY

SUMNER N. BLOSSOM, *Editor*

December, 1923



Will the ZR-1 Discover a Polar Paradise?

HERE is one of the most astounding stories of scientific possibility ever published.

Commander Green's exclusive article has all the pungency of romantic fiction, at the same time it is founded on the scientific observations of a veteran arctic explorer and corroborated by fascinating legends of the Eskimos.

Not since the days of Columbus has any venture held such power of gripping the world's imagination as the proposed voyage of the ZR-1.

In the issue of **POPULAR SCIENCE MONTHLY** for November, 1920, the prophecy was made that "a huge dirigible of the Zeppelin type will enable the explorer of the future to study the geography of the poles in a really scientific way." Now this promise is to be fulfilled in the projected transpolar flight of the new navy dirigible next summer. What will be the result?

Commander Green's entrancing picture of a balmy polar paradise represents, he says, simply a tremendous possibility of arctic aeronautic exploration. In his article he sets forth the facts as he has gathered them. Whether you agree with his theory or not, you will find it absorbingly fascinating.

By Lieutenant-Commander Fitzhugh Green, U. S. N.

IN THE proposed transpolar flight of the huge new navy dirigible, the ZR-1 (the *Shamdooh*), next summer, lies the most thrilling possibility that ever faced a single body of explorers:

In the center of the unknown area of the Polar Sea may be discovered a vast continent heated by subterranean fires, and inhabited by the descendants of the lost Norwegian colony of Greenland!

So wild is the idea as to tax the most glibly imaginative. Yet it is vividly encouraged and supported not only by history and tradition, but by the searching test of scientific analysis.

Witness the astounding facts.

Within boundaries of the Polar Sea spreads the greatest unexplored area on the surface of the globe: 1,000,000 square miles on which no human eye has gazed! Look at the map on page 31. Most of this enormous wilderness lies on the Alaskan side of the Pole. On the European side lies Iceland at a point corresponding roughly to the center of the unknown area opposite it across the top of the world. This fact is significant.

Experts are in nearly unanimous agreement that a new arctic land will be found by the ZR-1. Doctor Harris, the tidal expert in Washington, D. C., long ago declared that the data he had worked out from polar ocean currents all convinced him that the existence of a large land-mass near the North Pole is indisputable.

Add to this the array of evidence geologists adduce on the basis of terrific volcanic activity along a well-defined line leading up the North Pacific, through the

Japanese archipelago and the fiery Aleutians, and onward toward the Pole. This seismic axis plotted on the globe nearly bisects the unknown area of the Polar Ocean. Further, were this line swung through 180 degrees, it would touch Iceland, one of the most fiercely volcanic spots on earth. Another significant fact.



Will the survivors of the Lost Colony of Vikings who mysteriously vanished from Greenland centuries ago be found inhabiting a steam-heated polar continent? Eskimo tradi-

tion points in vivid terms the White Men searching suddenly northward to a wonder-land the natives long had known—a land of endless summer, rich in vegetation and game.

The giant new navy dirigible ZR-1 in test flight. If she makes the voyage across the North Pole next summer it will prove according to Vilhjalmur Stefansson, famous arctic explorer, "one of the turning points in history."

Still more: Not many years ago, in a particularly open season, the American whaler, Captain Keenan, reported he saw land northeast of Point Barrow. Peary, from Cape Thomas Hubbard, sighted distant peaks northwest. Such evidence is incontrovertible. The new continent seems already within our grasp!

So much for the land-mass. Now for its probable inhabitants.

Eric the Red discovered Greenland in 985 A.D. He brought back glowing tales of grassy fjords, long sunlit days, game-infested hills, ice-pans groaning under their burden of fat seals, bays teeming with fish.

Vikings Prosper

Colonization began at once. And so true did Eric's bright tale prove that the Vikings greatly prospered. In the archives at Bergen may be seen today the receipts for their princely contributions in ivory and oil to the ill-fated Crusades.

The last ship known to have returned to Norway from her arctic colonies arrived in the year 1410. We read that it brought a rich cargo; that its report was of happy, thriving Norsemen back north; of health and growing independence despite their rigorous environment.

Then, as in 1914, Europe became a shambles. Plague and war swept civilization. Pestilential disease ran a ghastly race with a horde of human murderers. Greenland fell out of the minds of man. Even the sea route north was forgotten. . . .

Lost Colony a World Riddle

Dark ages passed. Slowly Nature bred again in men the will to search her world for knowledge and for wealth. Greenland was rediscovered. Hans Egede established the first modern settlement there in 1721. But the grim report he made was tragic beyond belief.

The Norwegian colony, 10,000 people—perhaps 100,000—had, to a man, mysteriously disappeared!

"The greatest riddle in the history of the world," it has been called—the baffling mystery of the lost Norse colony. Where did they go?

Where didn't they go is a question more easily answered. Not to sea in ships, for they had but one or two; and Greenland, lying above the tree-line, gave them no timber for building more. Not slain by Eskimos, for Eskimos are the most peace-loving people in the world, knowing nothing of the art of war. Not,

An Adventurer in the Icy Desert

"WITH my own eyes I have seen in Greenland the ruined stone houses of the lost Norwegian colony," writes Commander Green. "We have tried to reach the polar continent, believed to lie in the Polar Sea north of Canada."

As an arctic explorer of wide experience, Commander Green—now aid to Admiral Williams, President of the Naval War College at Newport, R. I.—has made an exhaustive study of the fascinating possibilities of discovery of which he writes. Following his graduation from the United States Naval Academy at Annapolis, he joined the Crocker Land Arctic Expedition as engineer and physicist in 1913. He spent 3½ years in the polar regions.

In the spring of 1914, with MacMillan and two Eskimos, he sledged more than 1000 miles up across Enderby Land and out into the Polar Sea in search of land that tidal experts insist must lie in this million square miles of unexplored area. They also explored an unknown portion of Axel Heiberg's Land.

The next year after their relief ship had become imprisoned in the ice of Smith Sound, Commander Green, with two other members of the expedition, sledged south, passing down the uninhabited portion of the Greenland coast and reaching the Danish colonies five months later, in the spring of 1916. Reaching New York by way of Copenhagen in the autumn, he joined the Atlantic Fleet on regular duty. The following spring he became Flag Lieutenant to Admiral Rogers in command of the division of United States battleships attached to the British Grand Fleet in European waters.



Lieut. Com. Fitzhugh Green
U. S. N. from a photograph taken in the Arctic

like Europe, swept by some dread germ of awful virulence, for germs don't thrive in polar regions.

What then?

Examine the Eskimo tradition: It paints in vivid terms the White Men swarming suddenly north to a wonderland the natives long had known. Because of evil spirits, no Eskimo had ever dared this trail.

"The land is warm; is clothed in summer verdure the year around; is populated by fat caribou and musk-ox. It lies,"

they say, even to this day, "in the direction of the coastal trail-route north."

This route is that taken by our American expeditions. Peary, Kane, and Hayes all used it. It always has been the easiest route as well as the most productive of natural food in seal and walrus. For our explorers it has been a hard trail. But for the Norwegian colonists whose forebears had spent 10 generations north of the arctic circle it must have been less difficult to travel than were the western plains for our American pioneers.

Lured Northward

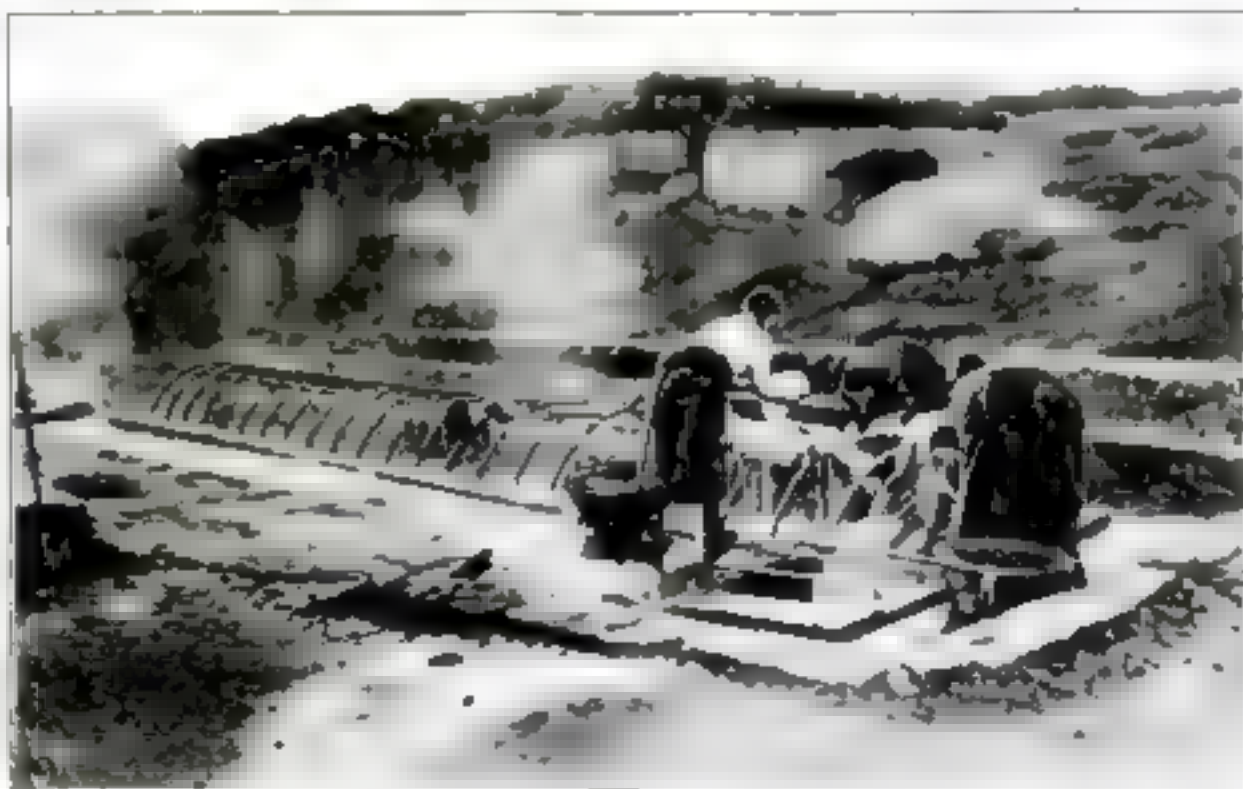
Picture the terrible situation in which the deserted Norsemen in Greenland found themselves: No outlet for their trade. No source of supply for the little but indispensable luxuries of life. No access to friends and families back home.

A generation—two, perhaps—of heartbreak and of longing; unhappiness goading the younger men

to travel northward. Perhaps a route to southern lands lay that way.

Suddenly like a bombshell breaks upon the weary colony the wonderful news: "We've found a polar paradise! Sunshine! Game! Grass! One moon's easy journey north! A short lap on the sea ice! Come!"

What had they to wait for? A century had passed since the last ship sailed. The last man who had seen a real Norwegian had died. The homeland was but a myth. So they "packed and, singing songs, departed," the native legend puts it,



Washday in Iceland, where hot springs well boiling mud abound. An engineering scheme for measuring the whole island by harnessing its steaming geysers has been projected recently. It is no idle dream, says Commander

Green, to believe that Iceland has a geographical mate on the opposite side of the Pole—a polar continent of mild climate and luxuriant vegetation warmed the year round by hot springs and geysers.



Our almost complete lack of the true very of a possible point path or by the R. A. based on Commander Green's map may be as follows: This last, he explains, because may be about the size of the state of Pennsylvania, and may be enclosed by a lofty volcanic range of

mountains based on eternal ice and snow. Behind a veil of fog may lie a fertile plateau where heat from hot springs, geysers, and boiling ponds makes life odd. The illustration shows the possible habitat and of an eternal demonstration of a volcanic range of Norwegian

'suddenly to the northward.' They never returned. This fact is not a step forward of what we think is true. They took a line of ash and lava, the very center of the polar pack. And the perfectly logical to suppose that their whereabouts will be found up there next summer by the dirigible ZR-1. In dramatic fashion

Go back to the scientific conclusion on which we base this amazing assumption. Iceland is a collection of volcanoes unsurpassed. She has 107 major craters within her tiny limits, and thousands of minor ones. Iceland's climate is temperate compared to the situation. The peace, the health, and the prosperity of Iceland's inhabitants were sustained by its natural warmth during the 200 years of isolation from Europe that it suffered at the same time and for the same reasons that the Greenlandic Norsemen were deserted.

Moreover, Iceland's lava flows are by no means always from conventional craters. The greatest of

them have come quietly from beneath the surface. We may deduce that subterranean fires smolder near the surface. It is not unreasonable for volcanologists to be warned of eruption by some warning of the earth and air.

Hot springs and boiling mud are found in every part of Iceland. There has been proposed an engineering scheme for heating the whole island by harnessing its steaming geysers.

This can be done by a system of pipes leading from the geysers to the main area of the island, and a system of pipes leading from the main area to the geysers.

It is with that of Greenland at the same latitude—minus 15° F. During the summer Icelanders enjoy a

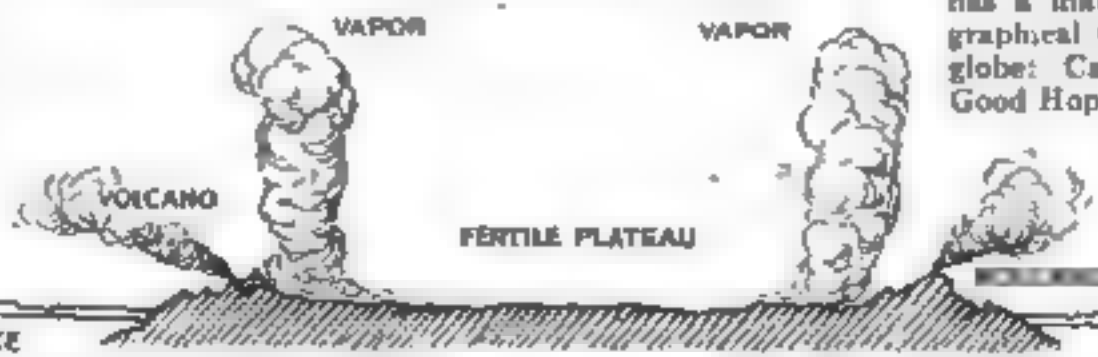
period quite comparable to that of our own New England States. Averages run up to 60° F.

It is no idle dream to claim that Iceland has a mate across the way. Geographical twins are common on our globe: Cape Horn and the Cape of Good Hope; the Mediterranean and the Caribbean, islands off Alaska and Japan, and so on.

(Turn to page 136)



How the barrier mountain range of the new land may appear from the distance



Commander Green's own idealistic drawing, showing a cross section of the imagined arctic continent—an undulating, fertile plateau, steam-heated by hot springs, geysers, and boiling ponds and rimmed by a volcanic range of mountains. Behind this barrier rises a veil of vapor



This map shows the proposed transpolar air route of the ZR-1 from Alaska to Norway. Crossing by a route of 2,000 miles and Arctic currents from 11,000 to 14,000 miles, the route would pass over no water, many of the icebergs being 10 or 20 miles across, and at the same time 4,000 miles from land. The flying of the ZR-1 would be the first step which the lost Norsemen may have followed to this imagined Arctic world.

Can Man Rob Earthquakes of Their Terror?

By R. E. Martin

WHILE Japan clears the wreckage of the cities of Tokio and Yokohama, leveled by the recent earthquake, the forces of science are being marshalled to find a way to prevent repetition anywhere on earth of what is now known to have been the most terrible disaster in history.

Not that science hopes to prevent other earthquakes. These cataclysms of nature undoubtedly are due to structural changes in the earth itself, and are consequently beyond the power of man to control. But science does expect in time to remove the chance of any such terrible loss of life and property as marked the Japanese catastrophe.

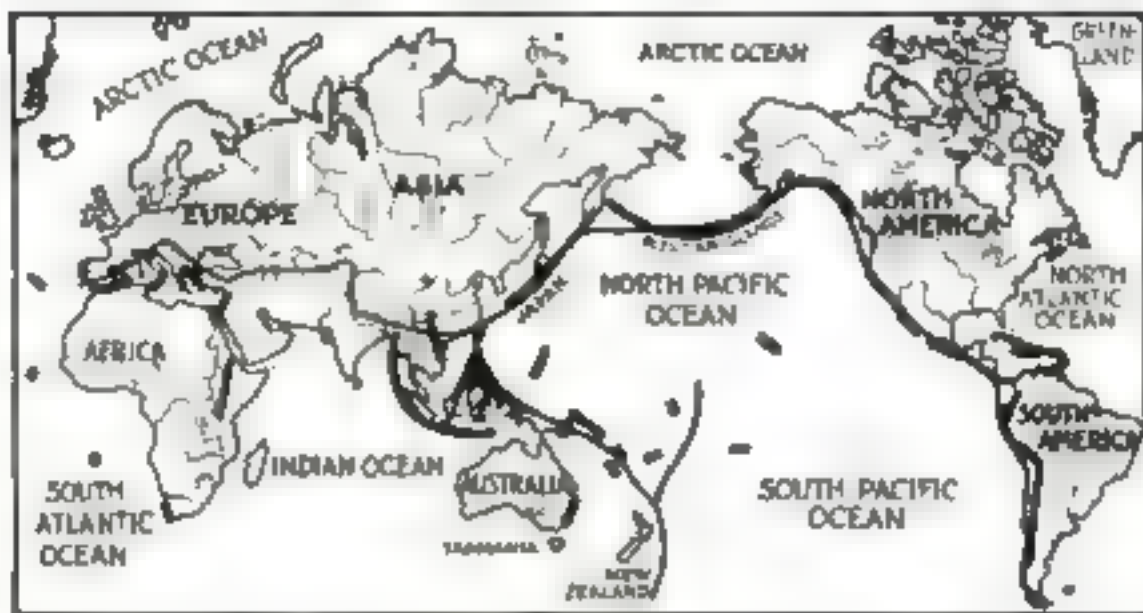
Means of forecasting earthquakes so that the inhabitants of a threatened area may flee in safety before the quake arrives, and the construction of earthquake-proof buildings—these are the goals toward which science is working. In the opinion of leading scientists the day is not far distant when people may live in larger security in places like Japan where earthquakes are of frequent occurrence.

4000 Earthquakes a Year

The tremendous importance of this task in which some progress already has been made is evident when we consider that 160,000 earthquakes actually have been catalogued and that about 4000 earthquakes are felt each year in different parts of the world.

Probably the most important work that has been done in the observation of the causes and nature of earthquakes has been accomplished since the beginning of the twentieth century. Previously all earthquakes were generally regarded as being of volcanic origin. Scientists now believe that most earthquakes are caused by wrinkling and slipping of part of the earth's crust, caused by strain resulting from shrinkage of the more plastic interior of the earth, contortion of the earth's strata, or changes in pressure in the crust itself. However, in some cases, subterranean volcanic action is believed to have been the cause of certain quakes.

The crust of the earth may be considered as a relatively thin skin or rind of rock, about five miles in thickness. As stone broken in a quarry splits along certain definite lines, so this outer covering of the earth tends to split along lines of weakness which geologists know as "faults." Variations in pressure—which may be caused by the weight of moun-



The black lines mark earthquake zones that girdle the world, forming narrow belts of potential disaster. Note that the United States, except for the Pacific Coast, apparently is free from danger of quakes. The most unsettled part of the earth's surface is

the western shore of the Pacific Ocean. This map was prepared by Prof. F. Omori, head of the Imperial Earthquake Investigation Committee of Japan, who nearly two years ago made the forecast that severe shocks would be experienced within six years

the friction between the blocks, something will give. They will buckle, and the buckling will correspond in a way to the movement of the earth's crust that causes an earthquake.

The most unsettled part of the earth's surface is the western shore of the Pacific Ocean. Here the crust is being thrust upward, giving rise to steep slopes. It was such a buckling of the earth's crust along the cracks believed to exist in the bottom of the Tuscara Deep, off the coast of Japan, that caused the recent disaster, according to theories so far ad-

vanced. The proximity of the Japanese coast to this great trough-like "deep," which goes down more than five miles, and the numerous earthquakes experienced by Japan, lend weight to the theory that pressure exerted by this tremendous volume of water is the cause of such disturbances.

Earthquakes under the sea are called seaquakes. So tremendous are the waves that they can travel at a rate of four or five hundred miles an hour, and still be detected after a journey of more than 10,000 miles.

Earthquakes are known to have occurred in the eastern part of the



How the recent earthquake in Japan split and crumbled the Tokio-Yokohama highway near Kawasaki, opening great gaps

tains or of the water in the ocean—cause movements or dislodgements between the sections of crust, which, of course, are constantly seeking to remain in equilibrium.

The situation may be compared with a row of building blocks, laid side by side and subjected to pressure from both ends. When the pressure becomes too great to be resisted by

ARM SHAKES BUILDING HORIZONTALLY

FLYWHEELS

LEVERS PRODUCE VERTICAL VIBRATIONS

ECCENTRICS

To test the ability of various types of buildings to withstand earthquakes, Professors B. Muto and A. Inohara of Japan have invented the engine-driven shaking table shown above. A model building is placed on a platform that is vibrated horizontally and vertically by means of eccentrics and levers to duplicate typical earthquake movements





A scene of appalling devastation along the coast of Japan, showing the results of the earthquake of May 1, 1906. The earthquake was caused by the

feature and shifting of the earth's crust. The earthquake was caused by the

United States at various times, but science scouts the notion of any quake of a devastating sort ever visiting any but the western coast of America.

Following the Japanese shock, Dr. Bailey Willis, emeritus professor of geology at Stanford University, asserted unequivocally that man and not nature is to blame for the disastrous consequences of earthquakes in localities like Japan, Chile, and California, which are known to be in the earthquake zone. His statement was based on observations in Chile, where he had been investigating causes of earthquakes for the Carnegie Institution of Washington, D. C. He pointed out that it is not the earthquakes themselves—the actual ground tremors—that cause the frightful loss of life, but the events that follow the quakes: the falling of masonry, the fires, the floods from reservoirs and similar things.

"To construct a house that will withstand an earthquake is not difficult if you can command the right materials and good carpenters," says Doctor Willis. "A point that has not been recognized generally by architects or engineers is that it is the earth that moves, while the house tries to stand still. If you could put a ball bearing between your house and its foundations, it would be safe in time of earthquake. This idea is embodied in every instrument for recording earthquakes and was applied many years ago by Sir John Milne to the construction of a

WHAT'S INSIDE THE EARTH

Recent study of earthquake waves has led to new scientific discoveries indicating that the earth's interior may be divided into three definite zones—a rigid elastic outer shell, a semi-rigid metallic intermediate zone, and central non-rigid core. This theory is deduced from seismographic records showing that the course of earthquake waves through the earth is curved toward the surface, therefore that the earth is denser and less rigid at its center. The three zones of the earth's interior are indicated in the illustration, which shows how volcanic outbursts throw up millions of tons of dust that travels entirely around the earth.



lighthouse in Japan. I believe it can be introduced successfully in some combination of bearings, springs, or shock absorbers.

"For the ordinary house a broad ditch packed with cobblestones on which there rests a well braced frame of heavy beams would not be a bad substitute. It would allow the ground to slide around under the house, which could be jacked back into position with reference to such unstable things as trees, garden walks, and roads at your convenience."

Doctor Willis adds that the displacement within the earth that results in rock slips that science now regards as the cause of earthquakes is developing below the surface for months before the quake occurs. This displacement usually does not actually reach the surface, but produces vibrations or waves that can be recorded by special instruments as a means of obtaining forewarning of the coming quake. The vibrations travel great distances at high velocity before they die out.

The instruments will have to be set up in many places," said Doctor Willis, "and records kept for years before the science of predicting earthquakes is set on a firm basis. I think it is not at all unlikely that in the future earthquakes can be predicted much as the weather is predicted now. Warnings can be sent to threatened districts and measures taken by the populations to save themselves."

The Story of the Mind

The Most Fascinating Psychological Series Ever Published

By James J. Walsh,
M.D., Ph.D.

AS A physician I have always been inclined to think that whenever anybody dies of typhoid fever, somebody ought to be hanged, because there has been criminal negligence somewhere; some one has permitted contaminating materials from a typhoid patient to get into the food or drink of a healthy person.

Banish Fear and Ignorance

It is the same sort of crime for human beings to allow their efforts to be palsied by dread of failure. It is criminal to allow the initiative to be hampered by lack of confidence; to restrict the display of energies just because of a lack of self understanding. This can be prevented by realizing that what one individual can do, others can do, and that the only reason for failure is lack of knowledge of personal powers and neglect to use them.

"But how may I acquire this knowledge?" you may ask. The answer is simple—through psychology.

And what is psychology? *Psyche* is a Greek word, meaning "mind," and *logia* is another, meaning "knowledge." Psychology—frequently misunderstood and generally cloaked in long, mysterious words—is simply knowledge of the mind. One of our newest sciences, it has a more intimate personal appeal and offers a wider application in practical usefulness to you and to me than almost any other science, old or new.

It brings us knowledge of our own minds—the way in which they work, their powers, capabilities, possibilities, and shortcomings. And, what is more important, it shows us how to make practical use of this knowledge—how to find greater happiness, health, and power through our hidden mental resources.

Why Men Fail

A great many men fail in life, not because they lack talent, but because they fail to employ their minds properly; because they do not realize or use the qualities they possess. When critical emergencies arise, men often prove to have hidden genius for leadership and unsuspected power of accomplishment.

Who ever heard of Marshal Foch before the war? Only a few professors of military science who knew him as a



Dr.
James J.
Walsh

writer of textbooks on tactics and strategy. That was all. But he proved to be one of the greatest men of history, capable of lending something of his own soul to millions of men and of welding them into

a firmly knit army that proved irresistible in action. It was in 1918, when the fate of nations and the future of civilization seemed to hang by a thread, to bring forth all the latent power within him. If it had not been for the Civil War, our own great General Grant would have sunk into a nameless grave after a commonplace and almost useless life. As it was, he proved one of the greatest leaders of the world's history.

War afforded the opportunity for Foch and Grant, but it did not make them. These men knew themselves. They knew the energy and power that was hidden within themselves. And they knew how to use these powers. Therein lay their greatness.

Every Task a Test

We can't all lead armies, but every task in our daily lives affords an opportunity to do something a little better than we ever have done it before, or to do it in a new way. We succeed or we fail according to whether or not we know our own mental powers and how to use them.

Of 10 men who crouch at the starting line in a foot race, only one can win, though they all have had equal training and practice in running. The winner possesses

natural advantages in speed and stamina that training and practice will not supply the others. But through training and practice, through developing the best there is in them, all 10 probably have learned to run faster than any of those who watch the race from the grandstand.

So it is with psychology. Learning to draw on the hidden powers of your mind and to put them to use may not enable you always to outstrip those with superior mental gifts. But undoubtedly it will give you a tremendous advantage over those who merely sit by idly, unconscious of the well-spring of power that is within themselves.

Psychology the Key

The aim, then, of practical psychology, or the knowledge of yourself as applied to yourself, is to enable you to bring out and use what is best in you. An understanding of it may mean the difference between success or failure in your life.

Psychology is the key that will open the door to the wondrous storehouse of hidden powers contained in your mind, and in the series of articles that I am about to begin in *POPULAR SCIENCE MONTHLY*, I shall endeavor to put that key in your hands.

AN ABSORBING story, which in its wonderful scope staggers imagination itself, is "The Story of the Mind," to be told by Doctor Walsh, beginning in the next issue. On this page the famous American surgeon and psychologist tells why he is writing the series for *POPULAR SCIENCE MONTHLY*.

In it for the first time a scientist of distinction will tell us in simple, non-technical words that may be grasped by anybody, how to obtain happiness, health, and power through the hidden resources of the mind.

Doctor Walsh's psychology is the psychology of business, the home, and every-day life. With fascinating fact and parallel he demonstrates that we may put our thoughts to work for definite external ends. And he shows us how to do it.

Doctor Walsh's first article, "The Machinery of the Mind," will appear in the January issue of *POPULAR SCIENCE MONTHLY*, on sale at your newsdealer's, December 10.



Divers Battle Hungry Sharks to Spear Sunken Gold

IN THIS picture our artist portrays vividly the dramatic adventures of divers in their hunt for the \$30,000,000 of golden treasure that dropped into the ooze of the ocean bed when a German submarine sank the White Star liner *Laurentic* off the Irish coast during the war.

Battling ferocious sharks with knives, 90 feet below the surface of the sea, these

intrepid deep-sea hunters have succeeded in recovering all but 30 bars of the gold bullion that was being carried to American bankers when the *Laurentic* went to the bottom.

As they grope among the bones of the sunken ship, the divers use a sensitive divining spear, with galvanometer dial attachment, to prod for the golden bars in the mud and silt. Whenever the spear

strikes a metal object, the clocklike dial aboard the salvaging ship *Racer*, indicates whether the spear point is touching gold or a base metal such as iron. The diver then receives his directions by telephone from the salvaging ship. The gold bars, as they are located, are raised in a tub.

In this way nearly 3000 gold bars, worth from \$5000 to \$10,000 each, have been salvaged from the deep.

His Hobby—a Two-Mile "Vest Pocket" Railway

How W. Cecil Gage Built a Toy Road from Odds and Ends

By Raymond J. Brown

SEVEN years ago W. Cecil Gage, then an insurance broker in New York City, attempted to retire from business. He removed to a country estate at Fishkill, N. Y., and prepared to settle down to the life of a country gentleman.

But his attempt to retire proved unsuccessful. Through an odd combination of circumstances he has gone into the railroad business. He owns and operates probably the most remarkable railroad in the world—a complete miniature system, with two miles of track. And every inch of that track, every one of the nine pieces of rolling stock that pass over it, he built himself almost entirely from secondhand materials.

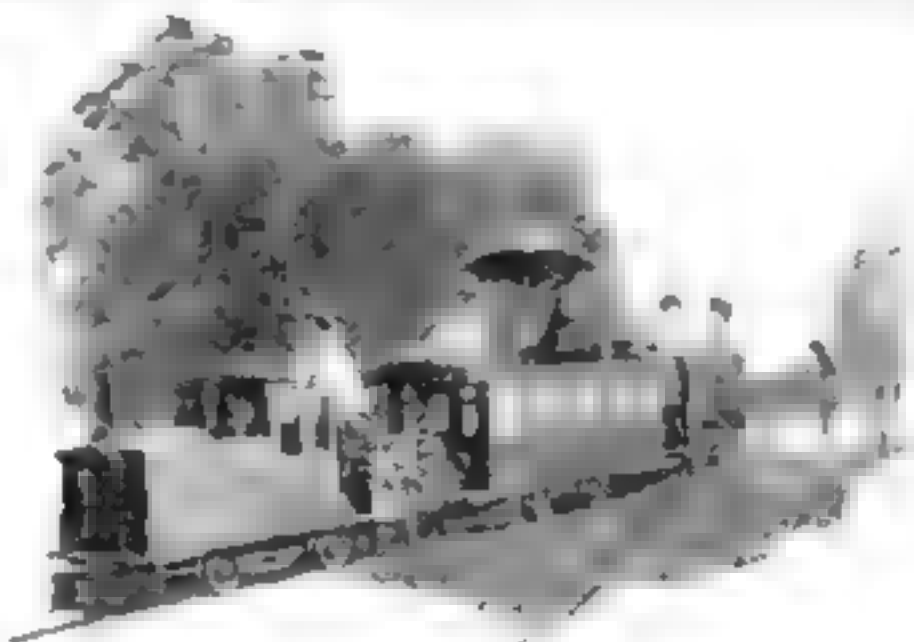
An Economical Road

The gasoline motor that drives the locomotive, the car wheels—narrow-gage trucks of the type used for mine cars—and the strap-iron reinforcement on the wooden rails represent the only purchase Mr. Gage made in the construction of his railroad. Everything else—cars, rails, ties, switches, and the single trestle that bridges a brook—is made of discarded lumber and metal, picked up around the estate.

Started as a convenience and pushed to completion as a hobby, the Gage narrow-gage road, which its owner calls the "Cecilwood Vest Pocket Railroad," now is a commercial enterprise, paying substantial dividends from passenger fares. At the same time it serves its original purpose of supplying a swift and convenient means of carrying farm products, fuel, and similar materials around the Gage estate. From every part of the country surrounding Fishkill, by motor, foot, trolley, rail, and ferry, almost a constant stream of persons of all ages pours into Cecilwood to make the circuit of the big Gage farm in the tiny cars. Mr. Gage estimates this year's mileage

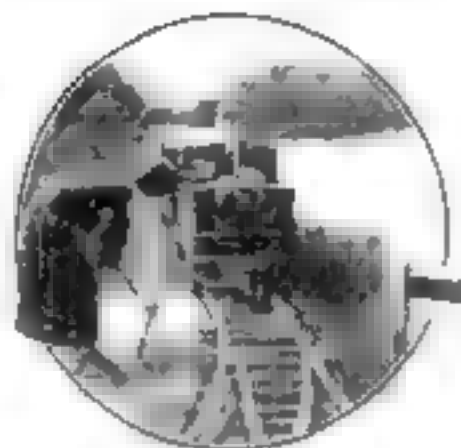
record of his little road to be well above 10,000.

The Vest Pocket Railroad owes its construction to the difficulty Mr. Gage encountered in disposing of the ashes from his household furnace during his first winter in Fishkill, when he found it necessary to carry the ashes about a quarter of a mile to dump them. Although he never before had tried to build anything, he constructed a little car, similar to a



W. Cecil Gage at the throttle of his eight-horsepower gasoline locomotive, taking members of his family for an afternoon ride

"THERE was a time," says Mr. Gage, "when I wondered what value my friends could derive from their endless pursuit of golf, fishing, photography, working with tools—whatever it was they rode as a hobby. Now, though, I understand; for from my railroad—my first and only hobby—I have taken more enjoyment and valuable recreation than anything else ever has given me."

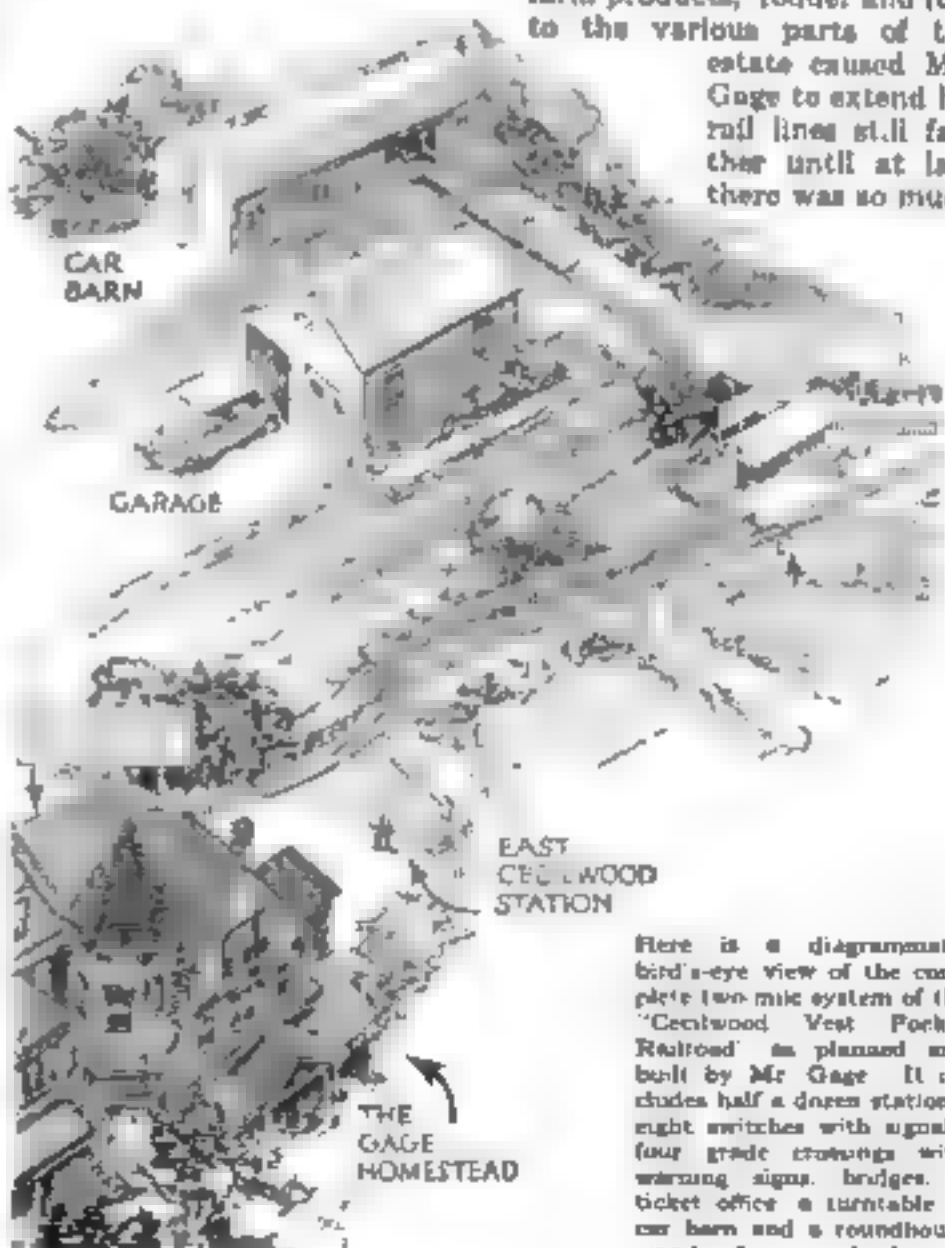


Approaching one of the eight switches of the "Cecilwood Vest Pocket Railroad." The rails are made from two-by-fours from a dismantled henhouse while the ties are from floor beams of the same building

railroad flat car, in which to haul the ashes. Then, because uneven ground made the operation of this car decidedly unsuccessful, he conceived the idea of running his car on rails.

These rails he constructed of "two-by-fours" that had formed the framework of a dismantled henhouse, and he mounted them on ties sawed from the floor beams of the same structure. During that winter his ash car, which he pushed back and forth with a pole, did valiant service. Meanwhile the ashes were utilized as ballast for the newly constructed tracks. In the spring Mr. Gage extended his tracks another quarter mile or so and built a second car. Both of the original cars are still doing freight service.

The necessity of conveying farm products, fodder and fuel to the various parts of the estate caused Mr. Gage to extend his rail lines still farther until at last there was so much



Here is a diagrammatic bird's-eye view of the complete two-mile system of the "Cecilwood Vest Pocket Railroad" as planned and built by Mr. Gage. It includes half a dozen stations, eight switches with signals, four grade crossings with warning signs, bridges, a ticket office, a turntable, a car barn and a roundhouse made from a henhouse



Hauling in the winter supply of firewood on midget flat cars

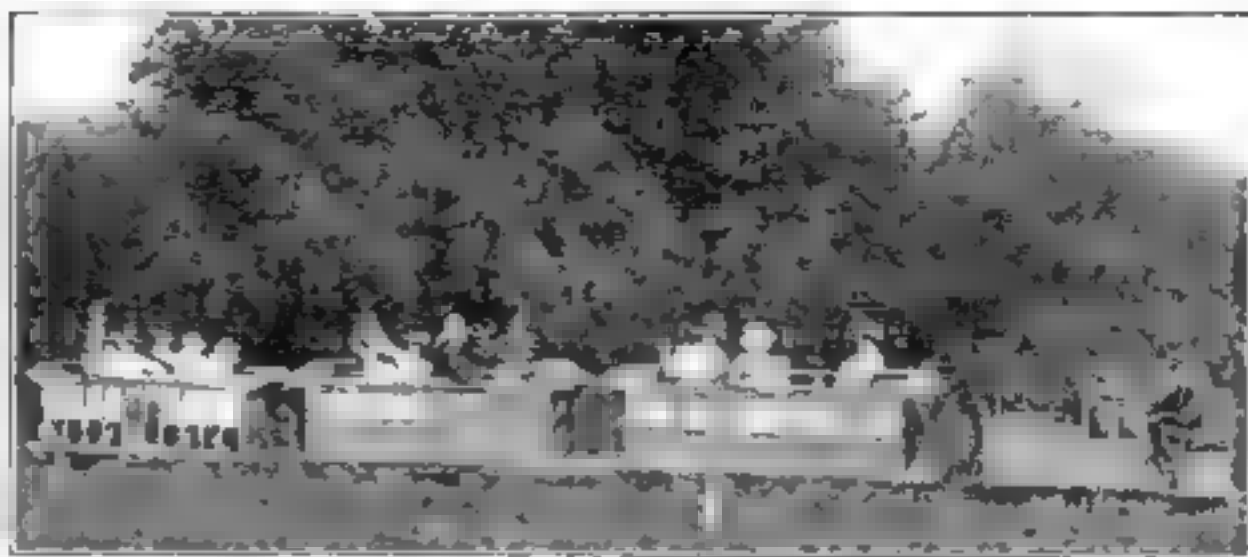
track that a locomotive was necessary. For a power plant for this locomotive, he bought an eight-horsepower gasoline motor of the type used to operate railroad hand cars. This proved successful in operation, and soon the task of extending and improving his little railroad became Mr. Gage's absorbing hobby, occupying all his spare time.

Little by little the road grew during the six years that followed, until now it has two miles of track, five passenger cars, two flat cars, a freight car, eight switches, four crossings, equipped with warning signs; a turntable, a snow plow, a ticket office and a half dozen stations. At night or during severe weather the rolling stock is run into a long chicken house, which serves as an adequate "roundhouse."

A Marvel of Amateur Workmanship

The entire system is a marvel of careful, patient workmanship and ingenuity in utilizing waste materials. It is especially remarkable for the fact that it was conceived and built by a man who had no previous skill nor training in the uses of tools. Mr. Gage asserts that he never could have done the work for pay; with him it was a fascinating hobby—a labor of love—and in consequence it received his best efforts.

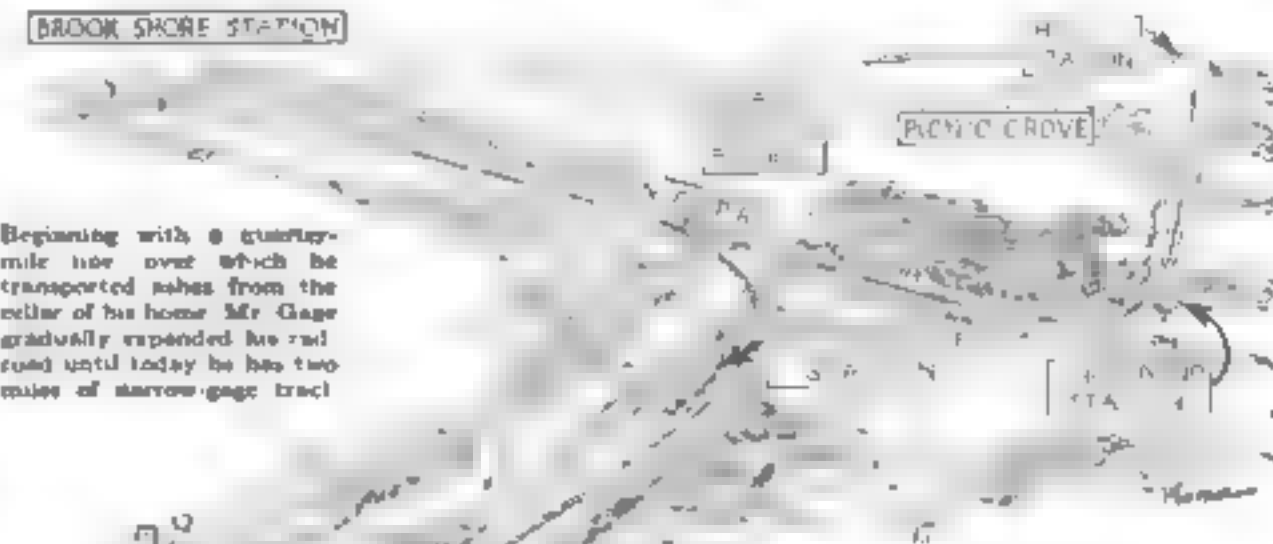
Two of the cars are constructed of the wood formerly used to board up the windows and doors of the Gage home in New York while the family was away for the summer. The other cars were made of old doors, packing cases, and the partitions of demolished farm buildings. Since Mr. Gage did not possess a machine shop he had to



Visitors flock to Coddwood to ride around the big Gage farm in the tiny passenger cars.

BROOK SHORE STATION

Beginning with a quarter-mile line over which he transported ashes from the cellar of his home Mr. Gage gradually expanded his railroad until today he has two miles of narrow-gauge track.



Although several thousand persons have made the trip around the picturesque Gage property in the Vest Pocket Railroad, there never has been an accident.

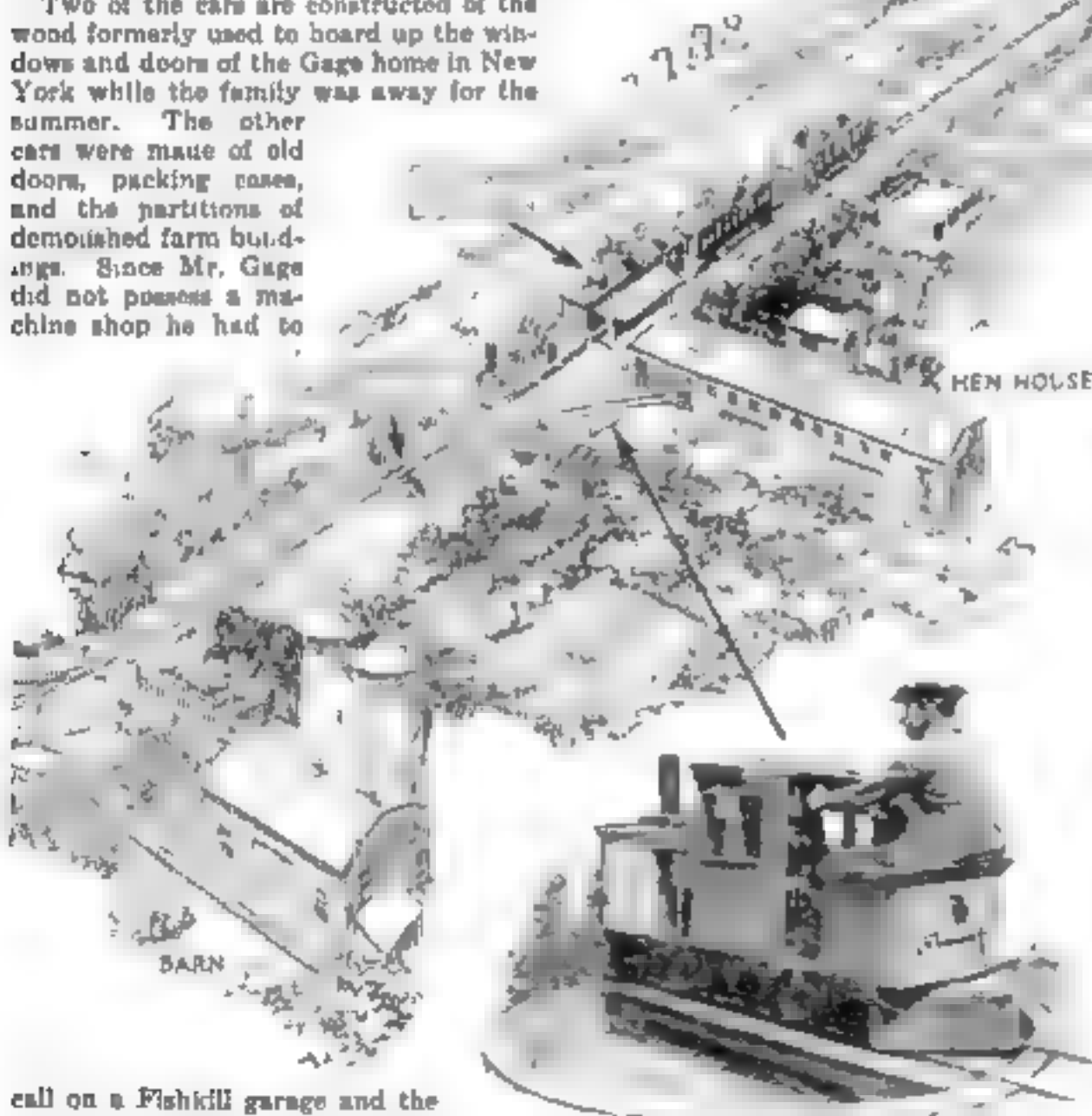
For a time Mr. Gage limited the list of his passengers to relatives and friends. The general public got its first chance to ride on the Vest Pocket Road at a church picnic held on the Gage property. After this the fame of the railway system spread so rapidly and so many persons appeared with requests for "rides," that Mr. Gage decided to accommodate all comers who were willing to pay the tariff.

Finds Happiness in His Hobby

"It wasn't the money I did it for," he says, "but with my road earning a little, I felt sort of justified in spending all my time on something that was merely a hobby and plaything. My railroad is the first real hobby I have ever had. There was a time when I wondered what value my friends could derive from their endless pursuit of golf, fishing, photography, working with tools—whatever it was they rode as a hobby. Now, though, I understand; for from my railroad—my only hobby—I have taken more happiness and enjoyment than anything else ever has given me."

So now the Vest Pocket Road runs on a definite schedule every day. And since Mr. Gage is at once engineer, conductor, passenger agent, traffic manager and repair crew, he asserts that the "retirement" which he went to Fishkill to find is largely figurative.

Operating the train and keeping the system in repair engage him from morning to night, seven days a week. He declares that he has less leisure time now, in his "retirement," than at any stage of his business career.



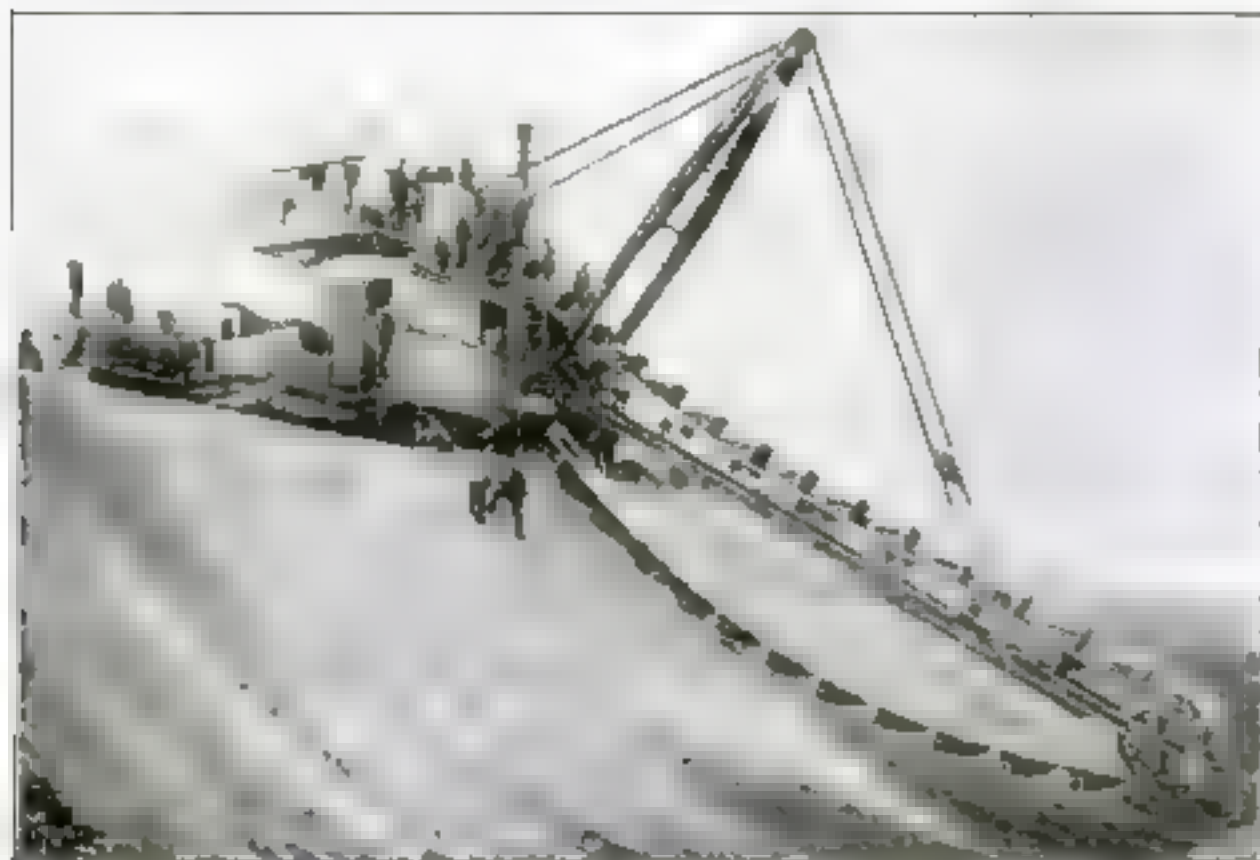
call on a Fishkill garage and the local blacksmith for aid in gearing the motor of his locomotive to the axle; but all the rest of his railroad represents the work of his own hands, aided by an ordinary kit of carpenter's tools.

The rails, 14 inches apart, are painted and tarred and protected on their inner top edges by strap iron. Except for the metal strip they are of wood. Comfort for

Gage and his locomotive on the tiny "roundhouse" turntable. Note the automobile spotlight that serves as the rear light; also the pipe smokestack.

the passengers is assured by elliptical springs on which the seats are mounted. The cars are about five feet long. Each is mounted on four eight-inch wheels, the axles being set close together to enable the cars to take curves without overturning.

GIANT EXCAVATOR DIGS FROM ABOVE



EXTRAORDINARILY rapid excavation is accomplished by this giant dredging machine recently invented in Holland. Instead of working in the hole

and paring up the diggings, as does a steam shovel, its scoops go down in an endless chain after the earth and bring it up, emptying it into waiting cars.

METAL GARAGE WELDED TOGETHER

BY THE ingenious use of old materials, a novelty in building construction was effected in Miami, Fla., recently when a garage was built on a



Unfinished building, showing tube frame

framework of old boiler tubes electrically welded together. Not a bolt nor a rivet was used in the entire building.

The roof of corrugated iron and the sheet-iron sides were welded to the skeleton. This building, which is 18 by 36 feet, is shown here while under construction. It is planned to erect a similar building 50 by 150 feet in ground dimensions.

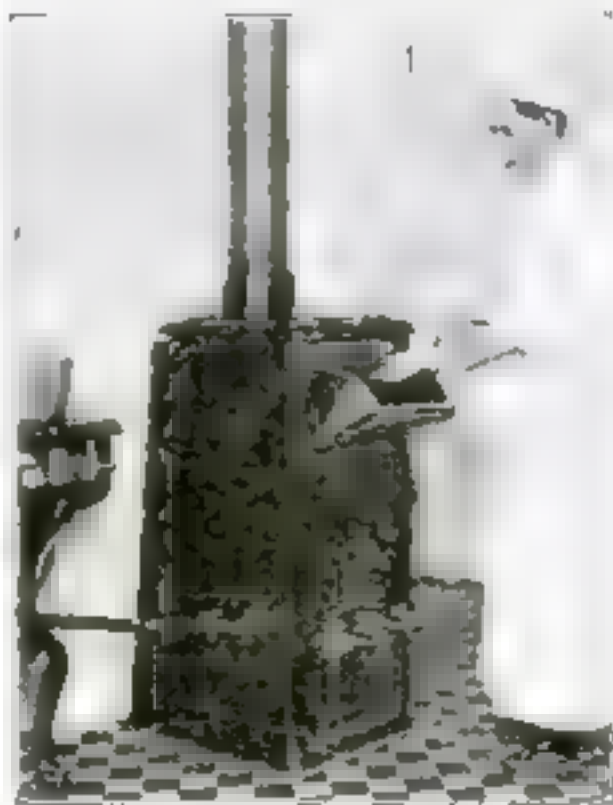
THE day is coming when diners will absorb electric vibrations instead of food, according to the prediction of Dr. Francis A. Cave of Boston, Mass. We'll eat our meals by attaching to our bodies apparatus connected with electric wires, he says.

HOUSEHOLD GARBAGE INCINERATOR

THE malodorous and none too healthful garbage can totters on its back-yard perch. No longer, it seems, need garbage accumulate to be carted to the public incinerator. A newly patented household incinerator consumes garbage in your kitchen as fast as it appears.

This remarkable heater creates a temperature as high as 1200° F., sufficient to destroy all combustible household waste, wet or dry, animal or vegetable. This intense heat is made safe for the kitchen by insulation consisting of a thick asbestos lining and an air space between the outer and inner walls of the heater. After the garbage is burned, the residue is a small quantity of odorless and sanitary ash, which may be kept in the incinerator until enough has accumulated to justify emptying it.

It is claimed that five cents' worth of gas is sufficient to destroy a bushel of garbage, the time required being less than one hour. On the issue of economy alone, the invention is a success.

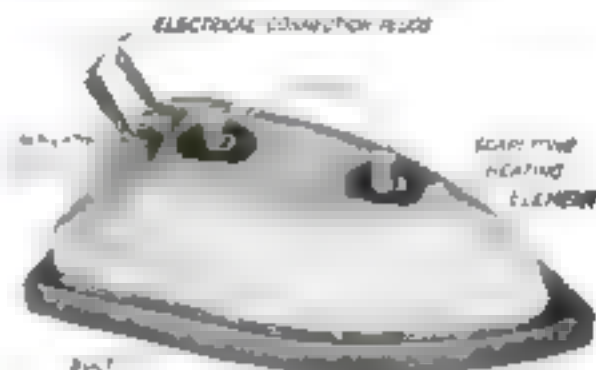


Intense heat burns up all garbage

Soapstone Electric Iron Conserves Heat

A NEW type of electric iron has been designed to conserve heat by taking advantage of the heat-storing qualities of soapstone, a substance once used for foot-warmers, bed-warmers, etc.

The ironing surface of the invention is a relatively thin metal sole, surmounted



The iron with soapstone heating element

by a soapstone block into which the heat is conducted.

A close contact is provided between the soapstone and the metal sole. To protect the housewife's hand from burns,



Insulation protects the housewife's hand

a layer of air is inserted between the cover and the soapstone, preventing excessive radiation of heat upward and sideways through the cover.

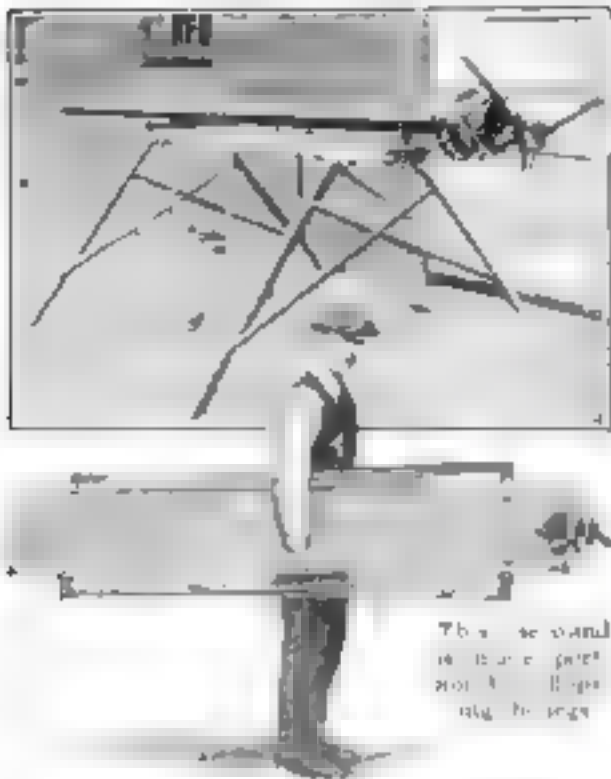
It is claimed that after a seven-minute connection the plug may be removed and ironing continued for 45 minutes.

Red Flags Do Not Anger Bull, Says Scientist

BULLS are color blind; therefore, waving a red flag before a bull arouses no more anger in him than waving a pink, green, purple, or white flag.

Such is the statement of Dr. G. M. Stratton, head of the Department of Psychology, University of California, after a six-month investigation of the subject. When Doctor Stratton and his assistants waved red flags in the faces of bulls and other animals, the reaction was one of curiosity only. He is positive the entire bovine family is devoid of color sight.

AS IF fulfilling Old Testament prophecies, modern science is preparing to harness the River Jordan to rejuvenate Palestine — the Land of Promise. This gigantic engineering project will be described dramatically in next month's issue.



Portable Vise Stand Has Collapsible Legs

THIS portable vise stand, designed to save steps for plumbers and steamfitters handling lighter sizes of pipe, consists of a stout plank firmly supported by braced collapsible metal legs. The wide spread of the legs affords steadiness while cutting or threading pipe. A hinged pipe vise is attached to the plank.

Four-Deck Stove Saves Heat

UTILIZING heat that usually is wasted up the chimney, a new type of stove permits gases formed in combustion to escape only after they have given up all their heat.

After passing beneath the primary cooking surface the heated gases are circulated through a series of metal boxes, the tops of which serve as successive cooking surfaces. From the third box the gases pass up the chimney.



The new four-deck heating system applied to cook-stove above and heater at the left

AIR GUN PASSES WHITE HOT RIVETS

THE danger from white hot rivets, speeding from the tongue of the heater boy and sometimes eluding the bucket of the passer, has been eliminated by the perfection of a pneumatic rivet-passing system in which the rivets are shot by compressed air to their destination through a flexible metal hose.

Pneumatic passers now in service can send rivets for a distance of 150 feet. The metal hose may bend around corners between the passer and the discharge end without stopping the passage of the rivets.

To start a rivet on its way, the heater boy drops it upon a balanced check valve that allows it to fall into the admission end of the hose. Then, when he presses on a pedal, a blast of compressed air is released from a reservoir, blowing the rivet swiftly to the other end of the hose. Meanwhile the quick expansion of air tends to cool the hose.



Above: Starting a rivet on its way through the admission end of a gun. The following text that describes how a check valve keeps the rivet from falling back.



Reaching its destination, the rivet enters a receiving chamber, where a cushioning disk prevents it from being deformed by the sudden impact.

Besides assuring safety for structural workers, the pneumatic system eliminates the usual waste of misdirected rivets that are seldom picked up and used.

CABLE CARRIES MAIL ACROSS STREAM

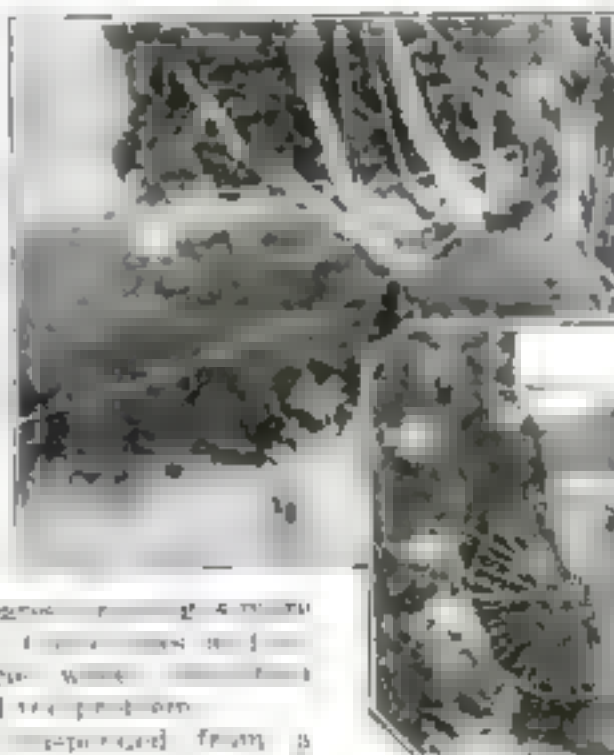
AN inventive farmer living in a rural district of California has insured prompt delivery of his mail, at the same time performing a kindness to the letter carrier, by constructing the novel mailbox carrier shown here.

To reach his home, mail must be conveyed across a river 300 feet wide, and in times of high water the nearest crossing is more than a mile away. The problem was solved by an old-fashioned bicycle wheel mounted on a pulley solved the problem.

The mailbox is suspended from a carrier cable by means of two small wheels attached to the top of the box. The lower part of the box is attached to a second cable running over the bicycle wheel pulley. Thus, when the operator turns the pedals of the wheel, the box is carried across stream along the top cable.

After the mail carrier has deposited letters in the box, it is hauled back, coming to rest inside a heavy strip of tire iron bent over a post.

A fence prevents stray cattle from running into the cable lines.



At the left is shown the mailbox being carried across stream by carrier and pulley cables. Below: The pulley cable from the bicycle wheel and the mail box carrier system.



“WHAT My Hobby Has Done for Me,” is the title of an unusual article by Arthur Stringer, popular American novelist, to appear in next month's POPULAR SCIENCE MONTHLY. His hobby is—well, see the January number.

Nine to One Your Eyesight Is Pulling You Back

By Guy A. Henry

General Director, The Eyesight Conservation Council of America

IF YOU never have had to lay aside a book in the most interesting part of your evening's reading because your eyes would not "carry on," you are one of the fortunate few. Even so the chances are at least nine to one that you have defective eyesight.

This statement may startle you. You may deny—probably indignantly—that you ever had any trouble with your eyes. You may say that they have always seemed adequate for your use. But, provided that you are more than 21 years of age, the chances are even greater than nine to one that some degree of trouble is there, whether you know of it or not.

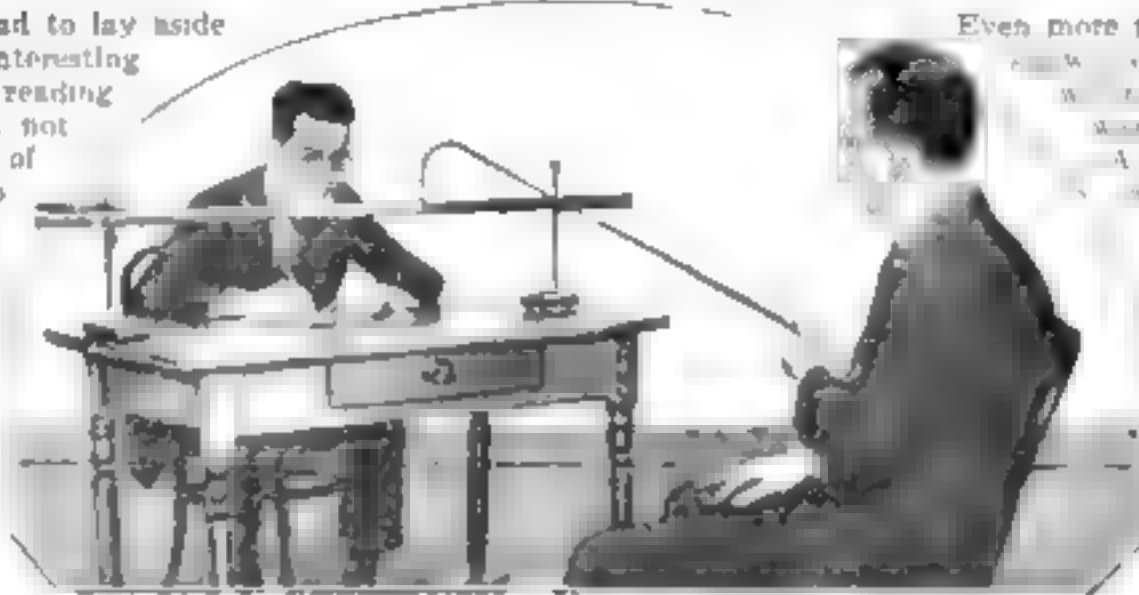
For it is only up to the age of 21 that this proportion holds true. Beyond that age, the prevalence of eye defects increases, until at the age of 40 scarcely a man or woman has perfect eyesight.

But you needn't be unduly alarmed. Science knows all about your difficulties, even if you are unaware of them yourself, and has provided ready relief in the shape of proper glasses. You may not even need glasses. Probably a little rest for your eyes now and then and the correction of some of your habits in reading or working may rid you of small defects that, while not warranting the wearing of glasses, may be responsible for headaches and other disorders of a nervous character.

Eye Strain Is Wasteful

If your troubles are thus lightly corrected, you are to be congratulated. Statistics covering a long period of years, borne out by a recent investigation among more than 10,000 employees of industrial and commercial concerns, show indubitably that not less than 66 men and women out of every 100 you know are so crippled by defective vision as to cause an appreciable economic waste. There is no physical defect that contributes more directly to inefficiency and is more responsible for waste of vitality, effort, time, and material than bad eyesight.

Not long ago I met on the street a man whom I have known for years, an executive of a large insurance company. Usually good-natured and happy, that day he wore a black scowl and his greeting was anything but cordial.



That eyesight influences the efficiency of the mind has been determined by this test with the Gelton Bar—a device that measures ability to perceive small differences in length.

While chatting with him I learned the reason for his ill humor. He had just had his eyes tested and had been informed that glasses would supply the only remedy for the headaches and fatigue that had been annoying him.

"Glasses!" he growled to me. "I don't need glasses any more than I need crutches! I'm not an old man—only 38. That eye man is an idiot!"

My friend's attitude is typical of that

Even more numerous than those who should wear glasses and who are not are those who are unaware that they need glasses.

A person whose eyes have been defective since early life is likely to remain ignorant of the defect unless he is informed of it.

Accustomed to seeing things blurred and indistinct, it never occurs to him that his visual pictures may be different from those of other people.

Recently a man of about 35 told me that the best years of his life had been wasted as a result of his failure,

through ignorance, to correct a defect in eyesight. As a schoolboy he had been "backward." Later he had shown little aptitude for work, drifting from job to job until the war came and he was drafted. An army examiner discovered that he was suffering from a severe case of astigmatism. Proper glasses were provided and he saw the world through different eyes.

As a result, since this man's discharge from the army he has become an expert machinist. He is making up the deficiencies in his education by studying at night, and is rated for advancement by his employers. All of this he might have accomplished years ago had any one discovered his handicap.

Common Eye Troubles

You may wonder why I lay stress on the use of glasses. I do so because they are the only sure means provided by science to aid the five common eye troubles that are due entirely to physical defects in the structure of the eyes. These are:

Far sight—caused by the eyeball being too short.

Near sight—caused by the eyeball being too long.

Astigmatism—caused by the transparent front of the eye curving more in one direction than in another.

Natural changes in the eye, occurring some time after 40 years of age, and usually necessitating the use of glasses for reading and other near work.

Eye strain, resulting from the extra work that we compel our eyes to do in an effort to contend with insufficient and flickering light, glare and too long periods of near use without intervals of rest.

These errors in many instances are serious, causing headache, eye ache, and various nervous disturbances. Moreover,

How to Save Your Eyes

DID you know that severe eye strain may cause you to use up fully half the vital force intended for all the organs of your body, draining the resources of your mind, your muscles and your nerves and producing severe fatigue?

To avoid misuse of the eyes, with its consequent ill health, medical science offers these suggestions:

Don't read or work in insufficient light. In well-illuminated places avoid the glare of lights shining directly into your eyes.

Don't read on street cars or buses.

Rest your eyes at the first sign of fatigue.

Be sure that your work is not at an uncomfortable angle with the line of eyesight.

Have your eyes examined by a competent practitioner for the correction of physical defects.

Don't refuse to wear glasses if you need them.

displayed by many persons in his position. They resent being told they need glasses. They feel they are being classified with the aged and the infirm. They fail to understand that glasses are the only means that science provides of correcting certain defects in the physical structure of the eye, from which many persons—between 25 and 60 per cent, according to the findings of school examiners—suffer either early in life or later.



Where Defective Vision Takes Its Toll

EXAMINATION of thousands of school children in the United States has revealed that between 25 and 40 per cent of the defective vision from which practically all of us suffer, comes during our schooldays, largely through faulty illumination.

In the workshop, with its artificial illumination, 66 men and women out of every 100 are handicapped in their work by defective vision. Bad eyesight is directly responsible for enormous waste of energy, time, and material.

Examine the two photographs below—one showing how a watch appears to normal eyes; the other, how it appears to defective eyes—and you will understand why many of us, accustomed from childhood to seeing things blurred and indistinct, go through life in ignorance of the faulty vision.

If the condition is permitted to endure for years, partial or total blindness may result from cataract, a disease that authorities agree frequently is the direct result of continued eye strain in the earlier years.

The abuse that the eyes of the average person receive has increased in the last couple of generations to a degree beyond estimation. Artificial illumination and the resulting pressure of modern commercial and industrial life are largely responsible for this increase. One naturally would suppose that modern improvements in artificial illumination would have made it somewhat easier for the eye to support its additional burden.

But such is not the case. The average eye has been unable to keep pace with the demands resulting from the extraordinary development in such illumination of the last 26 years. It has resented the additional work that has been placed upon it, and the result has been disorders, many of which people do not attribute to their eyes.

Conserve Your Eyes

We cannot, of course, reduce the speed and pressure of modern life even in deference to so important a thing as our eyesight. There remains, then, only one thing to do—make the best of modern conditions and learn how to use our eyes and not abuse and misuse them.

The first thing I should advise is periodic examination of the eyes by a competent refractometer—some one skilled in the science of measuring the human eye. Certainly you should have your eyes examined if you have never done so, for you may be contending unaware with eye strain, near sight, far sight, or astigmatism. But avoid those who offer treatment by mail.

When using artificial light, see to it that the illumination is sufficient. What apparently is too much light is

better than too little. Poor light will cause strain even to a normal eye, while there is little danger in over illumination, provided it is not accompanied by glare. The most common form of glare is that resulting from light shining directly into the eyes.

Glare is the greatest danger of artificial light, and may be minimized by shades and the use of proper glassware to modify and diffuse the light. Bare lights should not be tolerated. The slightest sign of fatigue, such as drowsiness or smarting of the eyes, is a warning for you to rest your eyes.

That there is a definite connection between the eyes and the stomach is indicated by the fact that the nausea accompanying "car sickness" is attributable to the unnatural movements of the eyes caused by the vibrations of the car. In fact, general health and the eyes are closely associated. Defective eyes frequently are the cause of many disorders.

Science Offers Hope

Even though the eyes of most of us will not register "normal" in examination, our plight is by no means hopeless. The human body always has managed to adjust itself to changing conditions of life. The adjustment, though, requires time. We of this generation are forced to bear the burden of a sudden change in our mode of life, caused by the demands of modern life and the recent development in the science of artificial illumination. That our eyes have not yet contrived to adapt themselves to the new conditions is not remarkable. But they will—if given time.

If people will take care of their eyes, use them and not misuse them, and exercise judgment and reasonable precautions, it is quite safe to predict that, despite the strain and pressure of our modern life, our eyes will not grow worse, but grow better.



If one of these watches appears distinct, the other blurred, your eyesight is normal. If both appear blurred, your eyesight is defective.



The new safety system for bank vaults. Accidental locking of the door automatically summons aid. A tank supplies oxygen until rescuers arrive.

If You Were Locked in a Bank Vault

WHAT if you were locked accidentally behind the thick walls of a steel bank vault? Can you imagine the horror of shouting vainly for help; the agony of the long night hours of waiting, with hope ebbing and the torture of slow, suffocating death creeping upon you?

The frequency, in recent months, of such tragedies with their untold mental and physical suffering, has led Alfred C. Bosson, a New York architect, to invent an automatic oxygen releasing device designed to save the victims of accidental imprisonment from suffocation. Mr. Bosson has supplied full specifications of his invention to American safety organizations, and the first complete apparatus now is being installed by an Ohio safe company in the new building of the Texas Bank and Trust Company, Galveston, Tex.

In the new safety system, dramatically pictured above by our artist, the locking of the vault door automatically switches on an electric

light within the vault. This light illuminates a card on which are printed instructions, at the same time revealing an oxygen tank close by. The accidental locking of the door also flashes an alarm signal, summoning police detectives.

Acting on the printed instructions, the

involuntary prisoner twists a stopcock on the oxygen tank, permitting the life-giving oxygen to escape into the vault at a pressure not exceeding 10 pounds. In very small vaults the prisoner puts on a mask connected with the tank; but in larger vaults the oxygen is allowed to escape directly into the room. A telephone permits the prisoner to communicate with his rescuers.

A small tank, it is claimed, will supply sufficient oxygen for the prisoner for at least 12 hours.

Many recent instances of imprisonment in bank vaults have escaped public notice, according to Mr. Bosson, only because they have not resulted fatally. In nearly every one of these accidents the victim, when released, has been in a state of collapse after a night of terror. In one recent case, a young clerk who was locked in a trust company vault at Paterson, N. J., had torn his finger nails and bruised his body by beating on the thick walls of his chilled steel prison.

HOW MANY OF THESE QUESTIONS CAN YOU ANSWER?

EVERY mail brings us scores of questions on mechanical and scientific subjects from POPULAR SCIENCE MONTHLY readers. While the questions touch on every phase of science, mechanics, and natural history, there are numerous duplications and from those, as indicating the widest general interest, have been selected the following twelve.

Our Information Editor has compiled thousands of answers to questions submitted by our readers. From these, other "monthly dozens" will be published every month in POPULAR SCIENCE MONTHLY.

How many of these questions can you answer correctly? To test yourself, answer each one of them to the best of your ability. Then turn to page 139 and read the correct answers.

See how near you can come to a perfect score. You'll find it an interesting game, and at the same time you'll be absorbing valuable knowledge.

- | | |
|--|---|
| 1. Are there any creatures that live forever? | 8. Are modern men less healthy than prehistoric men? |
| 2. Can submarines receive radio messages? | 9. Where did the Red Indians come from? |
| 3. Why does soap help to remove dirt? | 10. Why does food continue to cook after it is placed in a fireless cooker? |
| 4. What is the cause of earthquakes? | 11. What happens in your brain when you go to sleep? |
| 5. Are there special brain foods? | 12. How strong must an electric current be to cause death? |
| 6. Why is Maine colder than France, although about equidistant from the equator? | |
| 7. Why can a bird stand on a charged trolley wire without getting a shock? | |

A "Flower Show" of the Deep Sea



Here is a deep sea flower—a slow moving Sea Anemone being transported on the back of the comparatively fast lobster.

No more beautiful form of life is to be found than the *Plasma* or *Sea Anemone*, which may at times look like a flower. Seen at the Helsingfors station, this specimen of this species floating to the surface have attracted even the bees with their flowerlike appearance.

The *Sagartia* or *White* Sea Anemone, the least beautiful because it lacks a necessary resemblance to some exotic tropical plant. Its beauty is a fact for every biologist, for the sea is a garden as beautiful as any garden on earth, at any season, and the water world reaches

AT THE bottom of the water plants are animals. Strange though this may seem, science proves it to be literally true. Vegetation is to be found only near the surface of the water. The flowerlike form of its vast world, rivaling in beauty the choicest products of the greenest and most cultivated gardens of the land, is an animal.

The remarkable pictures on this page were photographed by scientists of the Biological station at Helsingfors. Extraordinary specimens were secured to get the subjects in all their natural beauty, and the water was added to penetrate.



This might be mistaken for a beet, or possibly an octopus. Actually though it is a photograph of the *Campylosyllis* Jellyfish with nascent floating veils of unusual beauty and coloring.



At the left are two Sea Cucumbers, among the strangest of all strange ocean creatures. They are cousins to the Starfish, shown here paying them a friendly visit, and to the Sea Urchin and the Sea Apple. Chinese epicures frequently pay high prices for Sea-Cucumbers.

Insect Actors in the Movies

Camera Shows Wonders of Microscopic World

By Louis H. Tolhurst

IMAGINE tossing a 120-ton locomotive up on your back and walking off with it!

You could do it if you had the strength, in proportion to your size, possessed by the ant. This has been demonstrated in my work with insects incidental to photographing them for the screen.

You have seen an ant crawling along the ground carrying a chip, breadcrumb, or some other burden that was a dozen times its own bulk, and probably you have wondered just how much that ant could lift in comparison with yourself. I was interested in this, so I made an experiment.

Coaxing an Ant

I spent the better part of three days recently trying to coax an ant to move a fragment of match stick that would correspond in size to a telegraph pole for us. The ant paid no attention to me and I was about to give up when it easily picked up the stick and carried it away. This convinced me that the insect could lift a much heavier burden, so I fashioned a tiny telegraph pole, tied it in the middle with a piece of grass, suspended the ant from a loop of string and after repeated trials succeeded in inducing it to take hold of the grass bridle.

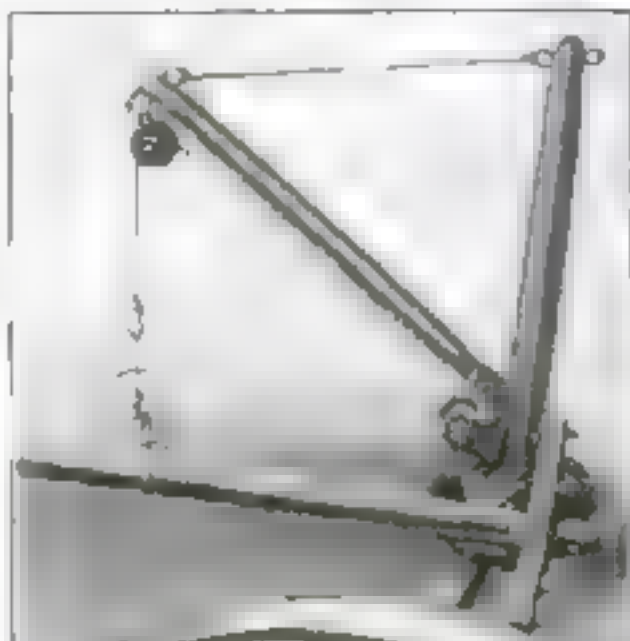
The ant lifted the pole clear of the table with its mandibles—with its teeth! Considering the weight of the ant, that pole represented a burden of 240,000 pounds, or 120 tons, for you or me!

Consider a crew of workmen swarming over a building carrying a few bricks at a time, while puffing engines with derricks swing the heavy girders into place. Then consider ants of the stature of men, with their tremendous strength magnified in proportion to their increased size! The ants would have no need of derricks. They would handle steel girders as we handle toothpicks, each insect would be capable of carrying a carload of bricks up a ladder! Man's prowess would be insignificant in comparison.

Wonders of the Insect World

There is an old saying that the man who lives in the world of the telescope lives in a very small world, while he who lives in the world of the microscope lives in a mighty, majestic world.

Scientists who recently photographed the sun can attest to the first half of the saying and I am a firm believer in the latter half. For 10 years my work has



Photographing insect "actors." Here is Louis H. Tolhurst, of Los Angeles, Calif. at work with the apparatus he has invented to make microscopic movies of insect life.

You have seen the house spider dangling at the end of his string, and probably you have observed how fast he can move with it. I have spent hours watching spiders build their webs. One day I destroyed a web and the spider quickly rebuilt it. I did this again and again and the spider demonstrated he could spin almost as fast as I could destroy.

His speed interested me so much I determined to find out just how fast he could work. In order to do this I rigged up a minute spinning wheel that could be turned as fast as the spider could produce his silk. Waiting until the spider emitted a tiny strand, I fastened it to the spinning wheel and started turning the crank. The faster I turned the faster the spider worked, until he reached the speed of 240 feet of silk a minute. And two skeins of linen thread, about 600 yards in all, was once considered a good day's work for a human operator at a spinning wheel!

Then I watched bees building their

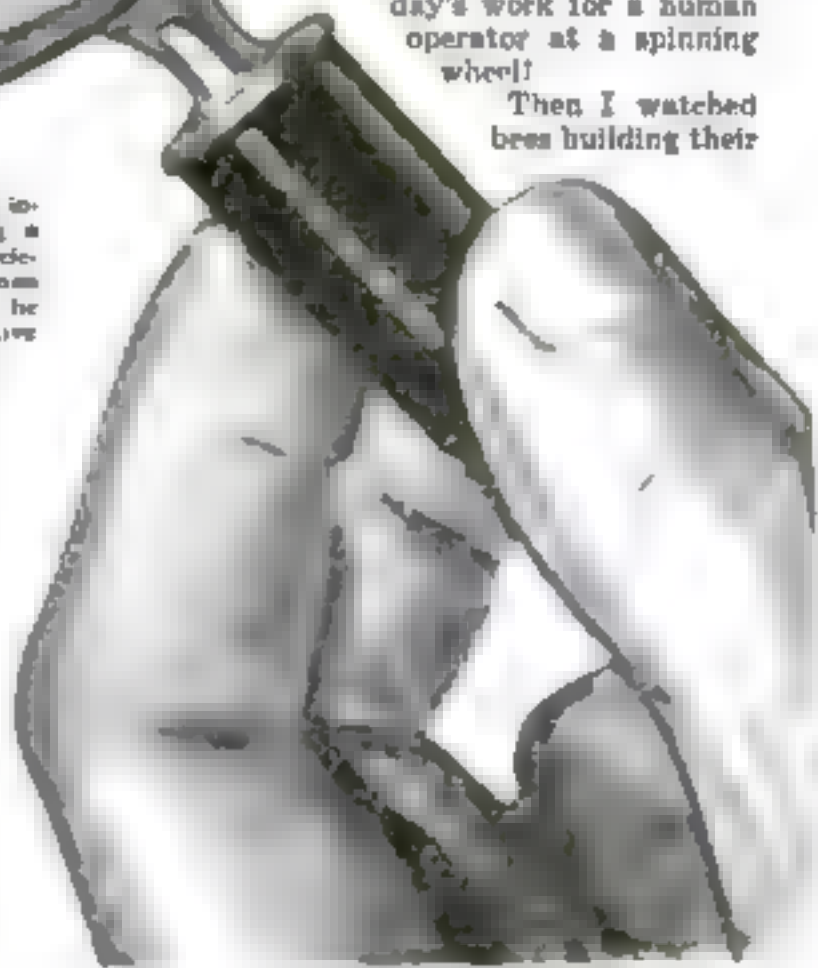


All photos courtesy of the U.S. National Museum.

Highly magnified view of the dramatic insect movie photograph above showing a common red ant lifting a miniature telephone pole with its mandibles. If a man had the same strength in proportion, he could lift a 240,000 pound locomotive.

consisted almost entirely of observing and photographing insects, first in still pictures and recently on motion-picture film, and the better I became acquainted with my insect subjects, the more I marvel at their wonders and capabilities. The strength of the ant was a revelation to me, but that was only one of the wonderful things I learned about insects.

The spider, for example, demonstrated that as a spinner of silk he was much more proficient than man with his old-fashioned spinning wheel.



combs. Their work showed a perfection undreamed of by human efficiency experts. Each bee knew exactly what to do and did it without waste motion. Scientists will tell you that the bee, in building the cells of his comb, uses angles that simplify to the best possible advantage the amount of wax he has to work with. No mathematician ever has been able to improve these angles. Who knows but what the bee understands mathematics that would baffle even Einstein?

The same holds for the common ant. Indeed, some scientists go so far as to place the ant next to man in intelligence. They point out the ant's ability to build homes, to keep farms, cattle, slaves, and cows to be milked, to make war in well organized battle formation; even to get drunk and dope itself with drugs.

Temperamental Insects

While there is some doubt about any such intellectuality on the part of insects, there is no doubt they have one characteristic in common with mankind. That is temperament.

Human stars of the screen are proverbially capricious. It is somewhat of a distinction, then, for me to be able to claim that I am producing pictures with a company of players that for whims, wilfulness, disinclination to work, and general ability to exasperate the director has no equal in the many studios of the great motion-picture industry.

You probably have seen spiders in the act of eating flies. I know I have. But when I wanted to film one in the act, I found myself up against it. I offered my spider fly after fly, but he would not eat.

Spider Film Star Is Coy

It took me nearly two weeks to coax him to eat. I believe he actually went hungry rather than do what I wanted him to do. And I spent nearly a week getting the spider to spin silk for me after I had built his spinning wheel. After the experiment was over, he built webs all over the studio.

As I said before, it took me three days to induce an ant to pick up a bit of matchwood, but when I threw such a stick into a hill of ants on which the camera was not focused, they fought to carry it off.

Of course, tiny creatures such as the members of my picture company cannot be set up and photographed as human actors or large



The ferocious looking house spider above demonstrated that as a spinner of silk it is more proficient than man. The lower photograph shows the spider feeding a tiny spinning wheel at the rate of 200 feet of silk a minute!

animals can be. Special apparatus is required for the work, and, since suitable apparatus was not available, I had to develop it myself.

Probably the only part of my equipment that would be at all familiar to any one versed in motion-picture production is my camera. That is an ordinary studio model, although it is mounted on a permanent platform and the film is turned by an electric motor, somewhat after the fashion of the cameras used for making film titles. The rest of the apparatus is especially designed for my needs.

In ordinary photography—except in very close work—a variation of a few inches, or even a few feet, will not throw the subject badly out of focus. But when the subject is invisible to the eye and must be magnified thousands of times in order to be photographed, you can see that a movement measured in thousandths of an inch would be sufficient to

ruin sharp focus. On this account it was necessary for me to develop a lens capable of 100 variations of focus within the thickness of a human hair. This may seem almost incredible.

Consider, though, that in photographing the microscopic life in a drop of water confined between two glass plates, the distance between the two plates of glass is microscopically so great that the swimming organisms farthest away from the lens are actually out of focus!

Using Heatless Light

Correct lighting, too, furnished a problem, for light from ordinary sources sufficient to illuminate my "scenes" contains enough heat to kill my actors. So it was necessary for me to develop a virtually heatless light. I do not claim, of course, to be the only inventor of heatless light, but my method is the only one that I have found satisfactory for microscope motion photography.

I cannot claim to have made any discoveries in entomology as a result of my motion-picture work.

But my camera has enabled me to bring to the eyes of every one the absorbing events of the kingdom of insects that heretofore scientists alone have been able to view.

Parasites in the Ant's Eye

I have made one-reel pictures of the bee, spider, and ant; but so far have scratched only the surface. In studying the ants I found that in some cases they have parasites on their eyes, tiny organisms living in their own tiny world. Such revelations make me wonder whether

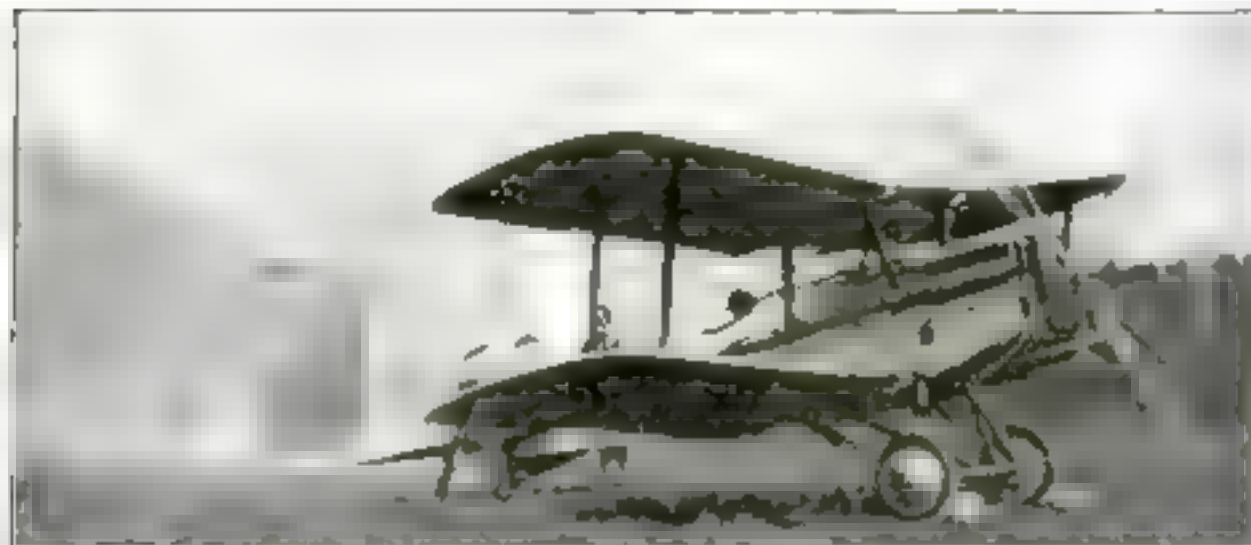
there is any limit to the nicety of nature's work. First the tiny ant, then its smaller eye and then complicated little mites with eyes of their own living and dying in that eye! And who can say that science will not discover even smaller creatures living in the eyes of these parasites?

The lives of the insects are full of mystery, charm, and human appeal. No one will ever exhaust their interesting possibilities.

THINK of an ant the size of a man and with the strength to lift 240,000 pounds and you have some comprehension of the fascinating interest which Mr. Tolhurst finds in his daily work.

Educated for the bar, this young California scientist has brought science to motion pictures and the wonders of insect life, hitherto to be observed only under microscopes, before the eyes of every one.

Read his story of the strange things seen in the world of the infinitely small. You wonder how man became the dominant creature in the world!



Plane Creates Gale to Test Glass

TESTING the resistance of plate glass by means of an artificial 125-mile gale created by the whurring propeller of a motionless airplane was the feat performed recently at the Curtiss Flying Field, Pine Valley, N. J. An SE-5 plane, equipped with a 220-horsepower motor, was used.

A sheet of plate glass five by six feet

and one quarter inch thick was placed directly behind the tail of the machine in such a way that the blast developed by the propeller would be directed against it with the least possible diffusion. The glass showed no trace of injury after the test. The velocity of the gale was measured by calculations involving motor revolutions, propeller pitch, and slippage.

A Disappearing Fan for the Home



The fan blades extended for use

AN ELECTRIC fan, the blades of which disappear into an electric-light chandelier when not in operation, is the invention of Clarence W. LeVelle of Wichita, Kans.

The fan is formed of curved blades pivotally attached to a rotating plate concealed behind the casing of the chandelier. From the casing lamps are suspended in artistic arrangement.

When not in use, the fan blades are swung back by spring controls into a concealed position.

Fingernails Grow 27 Yards

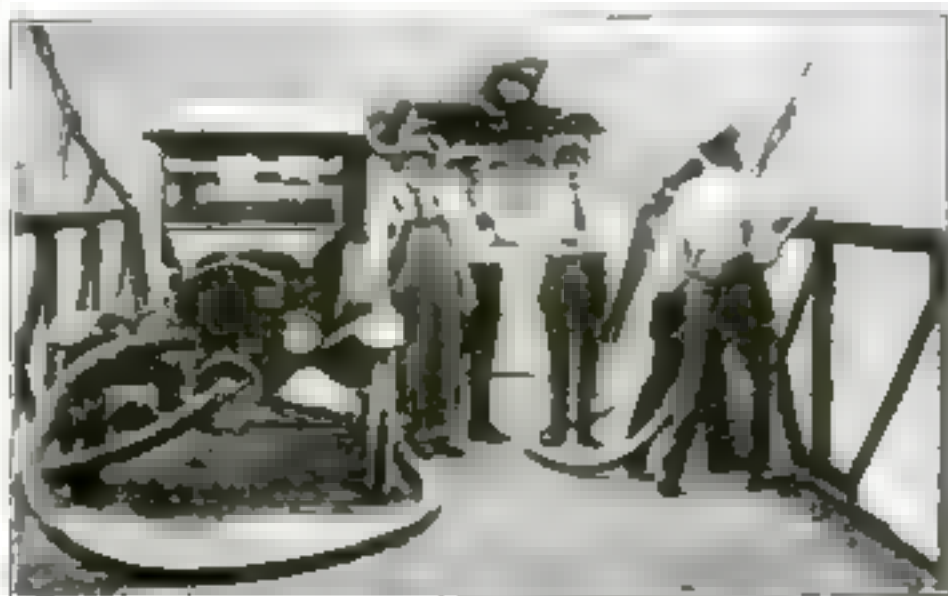
FROM a Swiss scientist comes an announcement that the average man of 60 has 27 yards of fingernails in his lifetime. He says that children's nails grow faster than those of adults; thumbnails faster than little fingernails.

Fire Pump Driven by Ford Engine

A SMALL, portable pump attachment for Ford cars, driven by the automobile engine, recently has been perfected for use in construction and road work, fire protection, and irrigation.

When the engine is running at a speed of 18 miles an hour, the pump is said to have a capacity of discharging from 200 to 250 gallons of water a minute at a pressure of 20 pounds. It will lift water by suction to a height of 26 feet. The first installation of the

pump and attachments requires about an hour and a half. Thereafter it may be connected or disconnected in two minutes.



An auto, with pump attachment, lifting a stream of water

Simple Spool Device Aids in Developing Photos

FACILITATING the work of the amateur or professional photographer, this simple film-developing device consists chiefly of two spools, mounted on spindles. Each spindle is attached to a vertical support, and the film to be developed is carried on the two spools.



Developing a roll of film held on spools

The upper spindle has a handle so that the film may be revolved. The vertical support is vertically adjustable, so that a film strip of any length can be accommodated. A semi-cylindrical basin just under the bottom spool contains the developer or other solutions, so that the revolving film passes through it.

Thus the operator can stand in a practically erect position while handling film.



Family Strong Box Has Combination Lock

PRYING fingers cannot disturb valuable documents if they are locked in this fire- and burglar-proof safety box recently designed especially for family use by a manufacturer in Fulton, Ill.

The box has a special combination lock, with dial control.

New Gum for Varnishes

"CUAPINOLE" is a tree from which a new gum is taken in Mexico. It is reported to be of such quality that it may be used in making the finest varnishes.

Support with Basin Keeps Christmas Tree Fresh

THIS Christmas-tree support fits any tree, preserves it from withering, and restricts its tendency to shed needles. It will hold a tree weighing 250 pounds, it is claimed.



The four legs of the device, spreading enough to allow a container of water to stand between them, raise the tree several

inches from the floor. Thus, although the base of the tree extends into the water, it does not rest on the dish. This supply of water keeps the tree fresh.

A wingnut adjusts the holder to the size of the tree butt, and holds the tree securely. Screw holes in the legs permit fastening them to the tree.

When not in use, the holder folds into a small, compact shape.



The air-pressure rifle

High-Pressure Air Rifle for Marksmen

ANY marksman can practice with a new high-pressure air rifle recently put on the market. It has the full range and penetration of a high-powered firearm. The rifle is .22 caliber and will kill all sorts of small game at 100 feet.

A plunger rod with a button that protrudes from the end of the gun, works back and forth in the gun barrel. Air is compressed in a chamber by placing the muzzle of the gun on the floor, holding the plunger rod button firmly between the soles of one's shoes, lifting the gun until the rod is out full length, and then bearing directly down. The number of strokes pumped in the gun determines the force of the shot.

Inexpensive pellets are used as ammunition. There is nothing in the gun to wear out and the only care necessary is an occasional oiling.



E. S. Wilson, government chemist, with 38 samples of bootleg liquor under test

Peril in Bootleg Poison Revealed

TEN to one odds against the man who patronizes the bootlegger were revealed recently when 38 samples of illicitly sold liquor, bought in 18 cities, were analyzed by Government chemists at Washington, D. C.

Only two of the 38 proved to be whisky of pre-prohibition grade. One was purchased in Boston and one in Washington, D. C. Two were passable synthetic gin, from Cleveland and Los Angeles. The remaining 34 samples were poisonous.

Portable Welding Outfit Carried like Knapsack

AN OXYHYDROGEN burning and welding apparatus that can be carried on the back of a workman like a knapsack has been invented in Germany. Heretofore it has been necessary to use two heavy steel tanks and long hose to convey the gases to places difficult of access. Sometimes the hose has been cut in confined spaces with serious results to the workmen.

The new outfit consists of two small steel tanks, one containing liquid oxygen; the other, liquid hydrogen. Pressure of the gases is controlled by valves. A third control regulates the mixture of the two gases for the flame.



England Has Speedy Plane Carrier

THE first vessel in the world especially designed as a floating landing field and airplane carrier, the *Hermes*, was put through protracted and comprehensive tests by the British Admiralty. The carrier is capable of a speed of 25 knots.

In the body of the *Hermes* are two hangars with room for 20 planes.

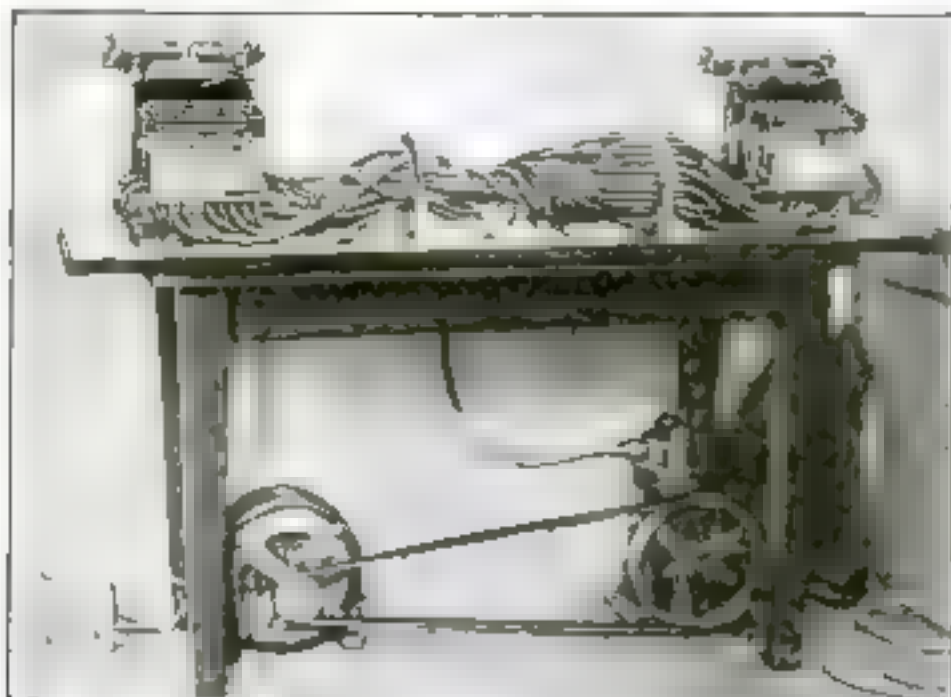
The funnel, observation tower, wireless apparatus, and operating quarters all are placed far up in the bow, allowing for a spacious flying deck extending more than three fourths the length of the vessel.

Planes are elevated from their hangars to the flying deck by electric lifts and cranes.



The new airplane carrier *Hermes*, showing spacious landing field behind funnel

Twin Typewriters Decode Messages



The remarkable typewriters are joined by a network of wires

BY A simple adjustment, a message typed on one of these typewriters can be made to appear on a sheet of paper in the opposite typewriter in any one of 280 codes.

Similarly, a message in any one of these 280 codes can, by the same sort of adjustment, be decoded on a sheet of paper in the other typewriter. The machines can be operated long distances apart.

This Shaving Brush Will Soap Itself

WORKING on the principle of the fountain pen, this remarkable new fountain shaving brush can be filled with an ever-ready supply of shaving cream. When not in use the brush is covered by a removable cover that protects the bristles.

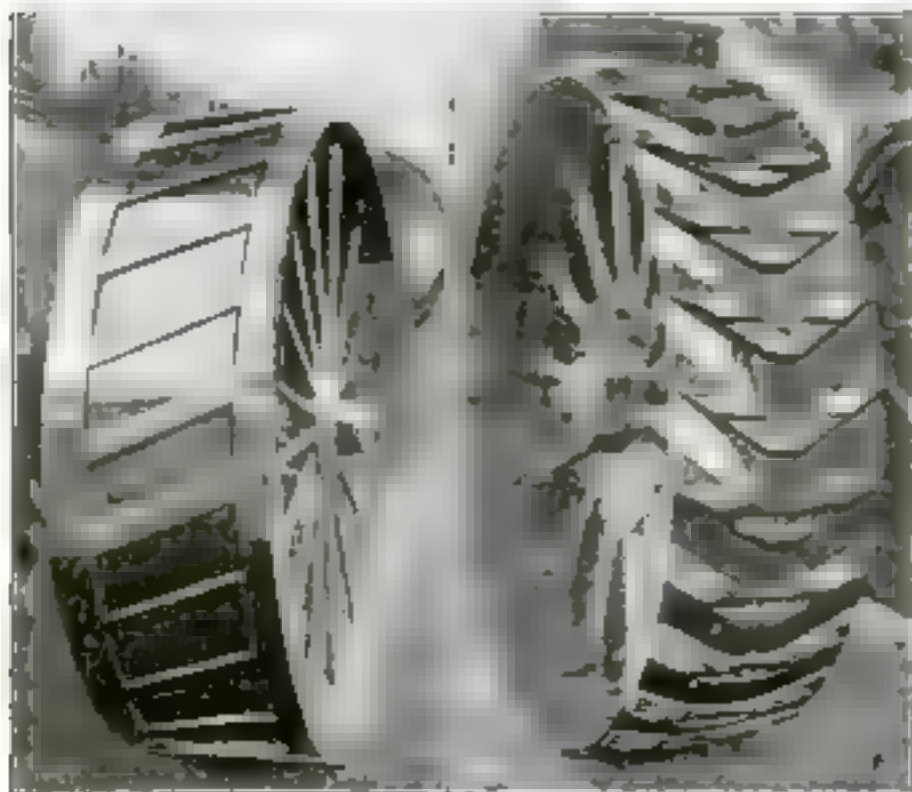
The brush may be regulated so that any desired quantity of soap or cream is forced into the bristles when required. This is accomplished by a plunger arrangement. This feature prevents waste of shaving cream.

The brush reservoir holds enough shaving cream for more than 70 shaves. When the brush has been charged with shaving cream, the bristles are dipped into water and the soap solution is then worked up on the face as with the ordinary brush.



Filling the fountain brush. The parts are shown in inset

New Tractor Wheels Protect Roads



The new tractor wheel

Ordinary cleated wheel

A TRACTOR grip wheel, which is said not to injure roads, has been invented by Calvin and Nelson Davey, of South Vienna, Ohio, and was recently successfully demonstrated by them.

A narrow steel band exactly as high as the grip bands edges the inner and outer circumferences of each wheel. When the wheel operates in a field, these edging bands sink into the earth and permit the grip bands to come into use. On a hard road the edging bands keep the grip bands from making traction.



Twin Camera Takes Movies and Stills at Once

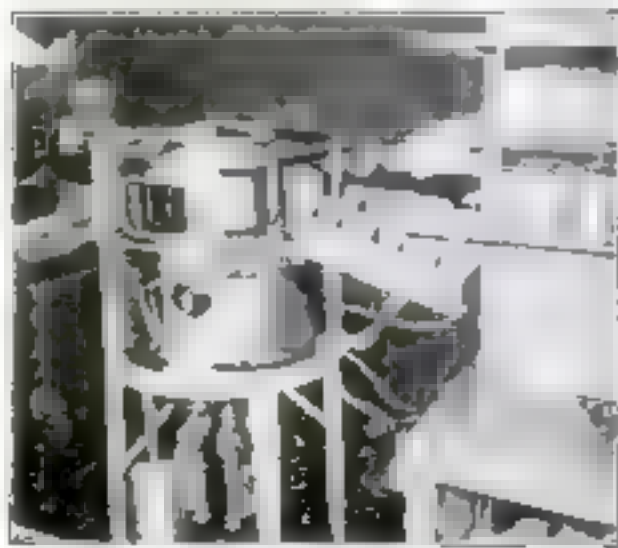
MOTION pictures and still pictures can be taken simultaneously, and focused by one finder with this Siamese-twin camera. Above is shown Frank S. Wilton, of Huntington Park, Calif., inventor of the camera, with which he photographed a large part of the film, "Hunting Big Game in Africa."

The motion picture part of the camera is fitted with four lenses, including a telephoto lens for taking close-ups of wild game.

Electric Machine Washes Glasses Automatically

AN AUTOMATIC washing and sterilizing machine for glassware, for use in restaurants, is electrically operated. Its capacity is 700 glasses an hour.

The glasses are conveyed by a circular motion to a cold-water spray to remove refuse, then to a hot alkali wash for cleansing, then to another cold spray to remove excess alkali, then to a sterilizing solution that destroys bacteria, and finally to an electrically heated hot-water rinse that assists the drying. The glasses require no handling once they are placed on the tray of the sterilizer.



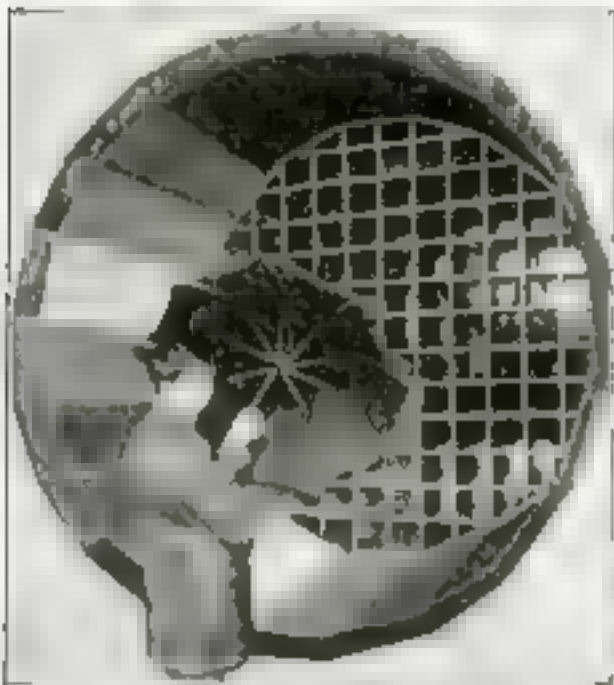
This machine washes 700 glasses hourly

Umbrellas Tested by Wind from Airplane Propeller

TO MAKE sure his umbrellas would not be turned inside out in any ordinary storm, an inventive umbrella manufacturer decided to subject them to airplane wind tests, which are the severest wind tests known.

An open umbrella, held before a seven-foot tunnel through which the wind was drawn by a 420-horsepower Liberty motor, withstood a wind strain of 34 miles an hour before collapsing.

As the umbrella was subjected to the full force of the air current, it was stated that in actual use it might stand an even greater wind. At the velocity of 34 miles an hour the operator had difficulty in holding it. The manufacturer claims to have been able to develop the strongest umbrella known.



Testing an umbrella in wind tube

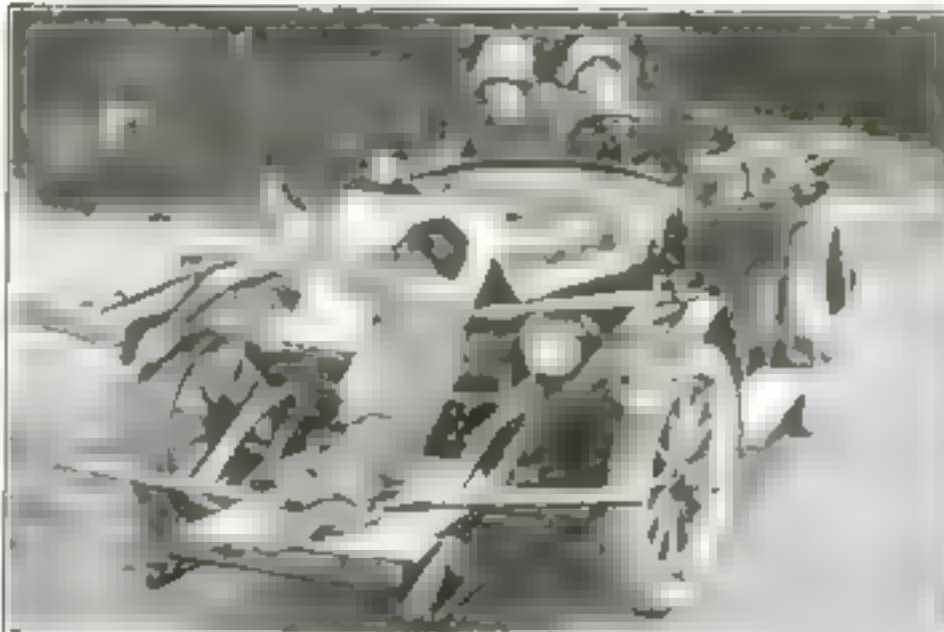
"Murder-Tree" from Brazil

A VERITABLE "murder tree" called *clusia*—an oge from the tropical forests of Brazil—is a new attraction at Kew Gardens, London, England. With aerial roots it strangles every tree near.

Birds deposit the *clusia* seeds on branches of neighboring trees. From the seed, roots grow toward earth, throwing out branches that envelop their victim.

Safety Bumper Has Canvas Stretchers

INJURY to a pedestrian struck by an auto equipped with this automatic safety bumper is practically impossible. Contact with the pliable front guard rail of the automobile causes two arms to spring out and draw the person struck on to two canvas stretchers, so designed as to prevent sharp contact with any part of the car.



Bumper arms draw the pedestrian onto the canvas stretchers



The river dredge and its Diesel engine

First Diesel-Electric Dredge Economizes Fuel

LESS than half the normal amount of fuel is said to be necessary for the operation of a new dredge at work in the Columbia River at Longview, Wash.—the first pipe-line dredge in the world to be operated by Diesel-electric power.

Fifteen barrels of fuel oil are required in 24 hours to operate the 825-horsepower Diesel engine, which in turn runs an electric generator to drive the electric machinery of the dredge. A steam-power dredge of approximately the same power and capacity requires 40 barrels of oil a day for her furnaces. At present prices this is said to represent a saving of more than \$50 a day.

The dredge was designed specially for shallow digging by James H. Polhemus, general manager and chief engineer of the port of Portland, Ore. It is capable of moving 225 yards of material through a 15-inch pipe-line in an hour. It is the smallest of a number of dredges engaged on a lumber mill and town site project, in which more than 12,000,000 yards of material will be moved. On such a huge project the saving that the Diesel-electric engine is said to effect will be considerable.



Portable Electric Hoist Saves Manual Labor

A PORTABLE and easily operated electric hoist, that permits one man to do the work of several, has been perfected by a Philadelphia concern for shops



Hoist is controlled with one hand

and factories where bulky materials and machinery must be moved quickly and often.

The device consists of a standardized chain hoist of steel, electrified by a heavy-duty motor, which may be adapted also to standard chain hoists already in service. A hanging controller is operated by one hand, leaving the other hand free to guide the load.

Where current is not available, or if the power fails, the hoist may be operated by hand as an ordinary block.

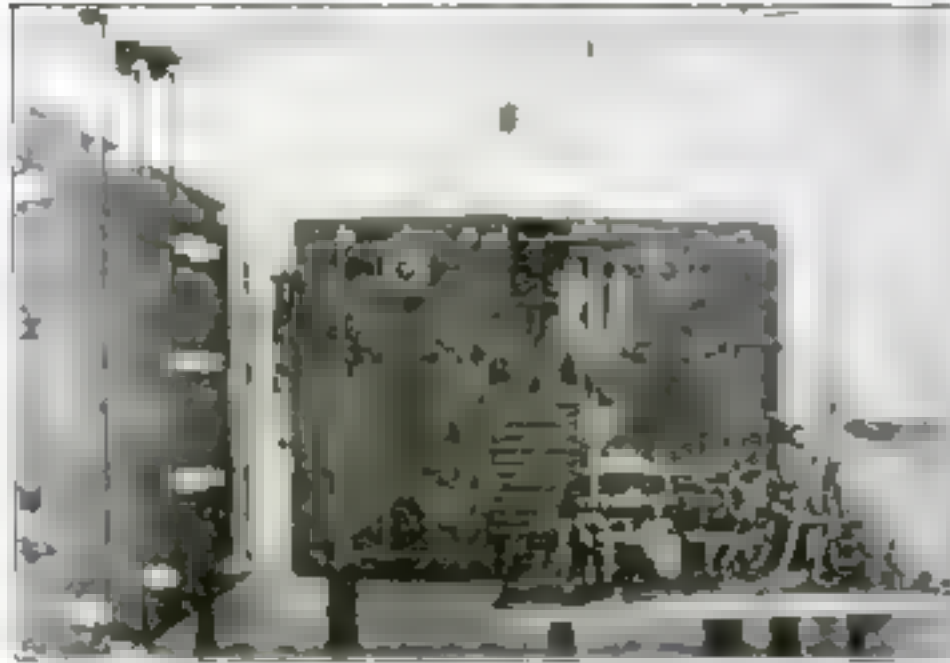
Power from the Sky May Light Our Homes

SCIENTISTS long have dreamed of turning to practical use the electricity that now is consumed by destructive lightning bolts. M. Jules Guillot, a French inventor, has perfected a machine to utilize this latent power.

He bases his experiments on the theories of static electricity proved by such scientists as Franklin, Lord Kelvin, and others. According to these theories, static is produced by the motion of the earth around its axis through the non-conducting ether. This motion causes the earth itself to become charged negatively, while the air around it is charged both negatively and positively.

Since like charges repel each other and unlike charges attract each other, the atmosphere's negative charges are thrown away from the earth's surface while the atmosphere remains as a positively charged blanket.

The difference of potential between the positively charged air and the negatively



The complicated apparatus used by M. Jules Guillot at the summit of Mont Blanc, Switzerland, to draw power from the air.

charged earth constitutes an unused source of electric energy. Since the amount of this difference depends on the distance from the earth of gas particles forming the atmosphere, Guillot has established his experiment station upon the summit of Mont Blanc in Switzerland.

At the station there are two antennae,

one extending toward the equator, the region of maximum density of the positive charges; the other consisting of a number of iron points extending vertically upward. The positive ions are attracted by the antennae pointing south and build up a charge upon a plate in the machine. A second plate is connected with the vertical antennae. Because of the difference of potential, this second plate absorbs a certain amount of negative ions that ordinarily would be repelled from the earth. Thus it is possible to establish a difference of potential or voltage within the machine that will cause a current to flow from one to the other when they are short circuited.

Instead of trying to use the voltage for this purpose directly, the charges are led off through step-down transformers.

It is claimed by the inventor that in this way he has been able to keep ten 50-watt lamps burning, utilizing only the static electricity of the air.

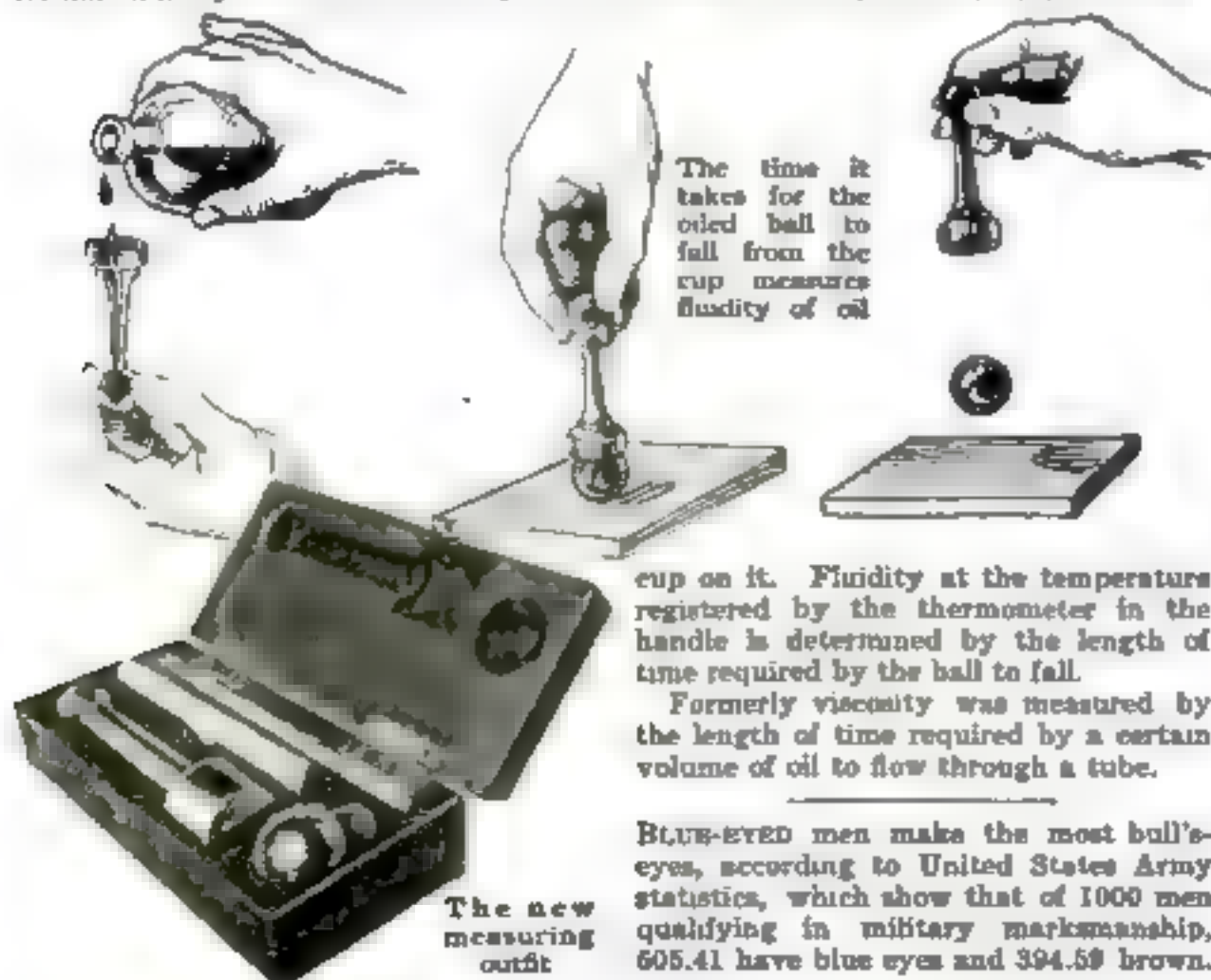
Measuring Flowing Quality of Oil

THE measurement of viscosity, or fluidity—that property of lubricating oils having to do with their resistance to flow—always has been a troublesome one to engineers. The most widely used instruments for measuring viscosity have been suited only to laboratory use and the involved computations necessitated have made them highly unsatisfactory.

Now, however, comes an extremely simple instrument that is said to determine fluidity far more accurately than

any device so far invented. It consists of a cup of steel or cast iron, provided with a hollow stem that forms a thermometer pocket extending into the metal of the cup. A steel ball fits into the cup. The concave surface of the cup has three minute projections that prevent the ball from making complete contact and also regulates the thickness of the film of fluid under test.

In taking a measurement of the fluidity of an oil, the steel ball is dropped into the oil and picked up by pressing the



The time it takes for the oiled ball to fall from the cup measures fluidity of oil.

cup on it. Fluidity at the temperature registered by the thermometer in the handle is determined by the length of time required by the ball to fall.

Formerly viscosity was measured by the length of time required by a certain volume of oil to flow through a tube.

BLUE-EYED men make the most bull's-eyes, according to United States Army statistics, which show that of 1000 men qualifying in military marksmanship, 605.41 have blue eyes and 394.59 brown.



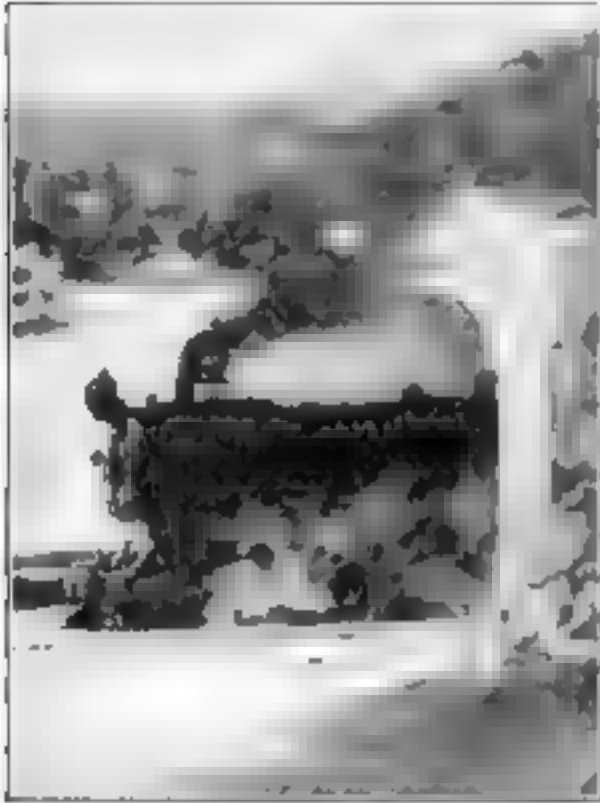
He Studies Microscopic Life in Yellowstone Geysers

THE sort of life that may have swarmed in primordial seas is being studied in the hot springs and geysers of Yellowstone Park with an extraordinary combination of high-power microscope and motion-picture camera.

Most scientists believe that, when geologic time was young, the earth's crust and its waters were extremely warm. They believe that only special forms of life could exist in those ancient seas. The present studies, under the supervision of Dr. R. B. Harvey of the University of Minnesota, shown above, seek to determine whether the microscopic creatures in Yellowstone's hot waters are similar to those ancient creatures, and to learn, if possible, the biologic secret of their heat endurance.

Engine Crews Endangered by Gas in Tunnels

AN ARTICLE in the September issue of POPULAR SCIENCE MONTHLY called attention to the danger to public health in carbon monoxid gas from the exhaust pipes of automobiles. Now the Department of the Interior, after an extensive investigation, has reported another grave menace—the possible asphyxiation of locomotive crews by the same poisonous



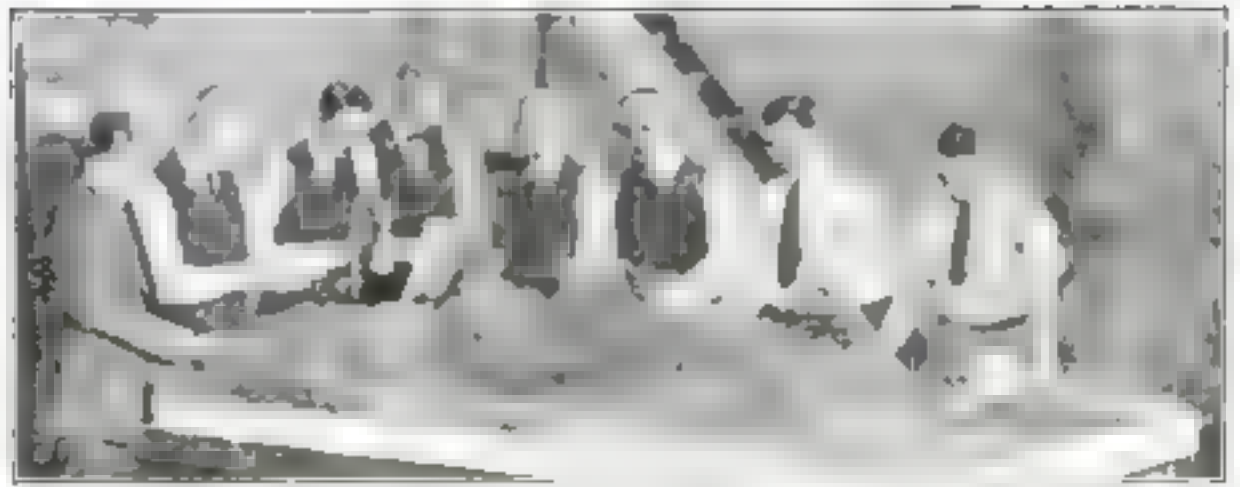
Poisonous carbon monoxid gas from engine stacks endanger the crews

gas from the engine stacks while passing through long tunnels.

The most satisfactory solution of the problem, according to experts, is to supply air to the engine crew through respirators attached to the air-brake pipe line of the train. These respirators consist of funnels connected with the pipe lines by rubber tubes and held by members of the engine crew near their faces. Valves controlled from the engine cab regulate the flow of air for normal breathing. The pipe lines supply pure air for 30 minutes.

Electrical Bath Cure

ELECTRIC baths are made possible by a novel electro-therapeutic apparatus developed by two physicians of Newark, N. J. The patient is placed within a magnetic field in a cabinet, where he may be sweated, baked, or bathed with electric light, according to the treatment his ailment requires. At no time is he in contact with a primary electric circuit, as only induced current is used.



U. S. Has School for Hay Inspectors

A TRAINING school for Federal hay inspectors, the only institution of its sort in the world, has been opened in Auburn, N. Y., under the direction of the U. S. Department of Agriculture.

Completing their training, these in-

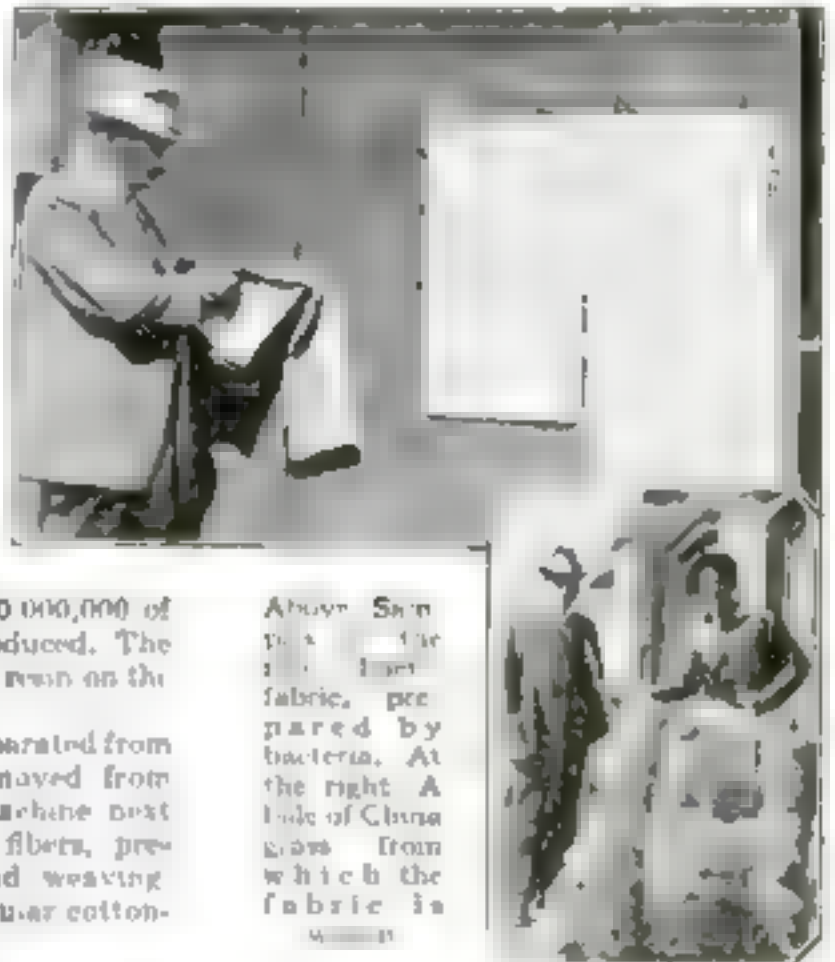
spectors are distributed throughout the hay producing sections of the country, to issue certificates upon hay that meets Federal standards. The men are shown above at work in the school grading hay according to the government standard.

Grass Fabric Made by Bacteria

WITH bacteria for assistants, Jonas Brolin, a textile engineer of Oakland, Calif., is said to have manufactured a fabric as fine as linen from China grass. The new cloth is said to cost far less than those for which it is a substitute.

The grass is soaked in tanks of water over which are spread bacteria that reproduce with astonishing rapidity. A cubic inch of water is said to contain 2,000,000,000 of them soon after they are introduced. The bacteria attack the gum and resin on the grass fiber.

When the gum has been separated from the fibers, the grass is removed from the tanks and dried. A machine next softens and subdivides the fibers, preparatory to the spinning and weaving. These final processes use regular cotton-manufacturing machinery.



Above: Seen to the left, the first fabric, prepared by bacteria. At the right: A bale of China grass from which the fabric is woven.

Snowflakes as Patterns

LOOK at your necktie and see if it has an unusual design. Perhaps that design was suggested by a snowflake.

"Snowflakes are used by silk manufacturers extensively as patterns," says Wilson A. Bentley, speaking of his article for next month's POPULAR SCIENCE MONTHLY. "Jewelers fashion delicate designs from ideas they get from snowflakes. Even biscuit makers transfer Nature's handiwork to their cookies."

Mr. Bentley's is a remarkable story of a farmer whose fascinating hobby made him famous. It is full of the wonder and romance of science.

Evolution—A Universal Law

Concluding Article in "The Story of Man and His World"

By E. E. Free, Ph.D.

THE subject of evolution is like this round ball that we live on and call the earth. It is so vast that no man can see more than a little of it at once.

To any single human eye the earth seems nothing but a broad, flat plain more or less wrinkled with mountains and scratched here and there with lakes or rivers.

A Limited View

Similarly, it seems to many people that the theory of evolution means merely an idea of the bodily origin of man; that it is the story of how this wonderful body of ours has been developed in the course of millions of years out of simpler and more primitive kinds of creatures.

This really is, of course, one of the things that evolution means. It is the story of the evolution of man as we have been telling, in the main, in the previous chapters of this serial.

But this is only a very small part of what is included and implied in the idea of evolution. The whole theory of evolution is as much more than man as the whole earth is more than your dooryard. It is probably the grandest and most far-reaching idea ever grasped by the human mind.

The idea of evolution may be defined, as I have explained in a previous chapter, as the idea of change. Things alter as time goes on and become new things. The unending panorama of growth and alteration is the universal law of life.

All Things Change Continually

Unliving as well as living things change. The earth changes. Mountains are worn down. Rivers alter their courses. The oceans advance and retreat. Ice sheets spread and disappear. The eternal hills are not eternal. The fixed stars are not fixed. Everything in the universe—man and man's ideas, the world he lives on, the sun that warms him, the stars that he looks up to and wonders at in the sky, even the chemical elements that make up the machine that man calls his body, each and every one is in continual change. "Permanent" things seem permanent to us only because we live so short a time. If a lifetime were a billion years, we should see the mountains melting before our eyes, the stars racing across the sky, the earth heaving and wrinkling under us.



HOW INVENTIONS EVOLVE
The first transportation of man was by the animal. Then he learned to use the wheel. Then he learned to use the engine. Then he learned to use the motor. Then he learned to use the automobile.

There is no such thing as a static universe, but everything is changing, moving, producing something new. Everything everywhere evolves.

Let us take a familiar example—the evolution of inventions. Many people remember the first telephones; a few remember the first typewriters; nearly all of us remember the first automobiles or the first airplane, with the Wright Brothers riding out in front of it on a little board, like some one perched precariously on a window sill. Compare these recollections with present-day realities. Inventions, machines, human devices of all kinds obey the universal law. Not even so simple and satisfactory a thing as the buttons on your coat remain the same for 10 years in succession. This is evolution.

Think of the history of transportation. The first men were their own wagons; when something had to be moved, they carried it themselves. Then someone learned how to catch wild oxen and make them into beasts of burden so that one man, using his brain to direct the muscles of his ox, could carry more weight and could

take it farther in a day. Soon some other genius invented a drag of poles to slide along behind the ox and still more weight became transportable. Finally, men learned how to make wheels and wagons that rested on them and how to catch horses that could move faster than oxen and go farther in a day. And today we have tamed gasoline to replace the horses on the highways and steam to transport things still longer distances over rails.

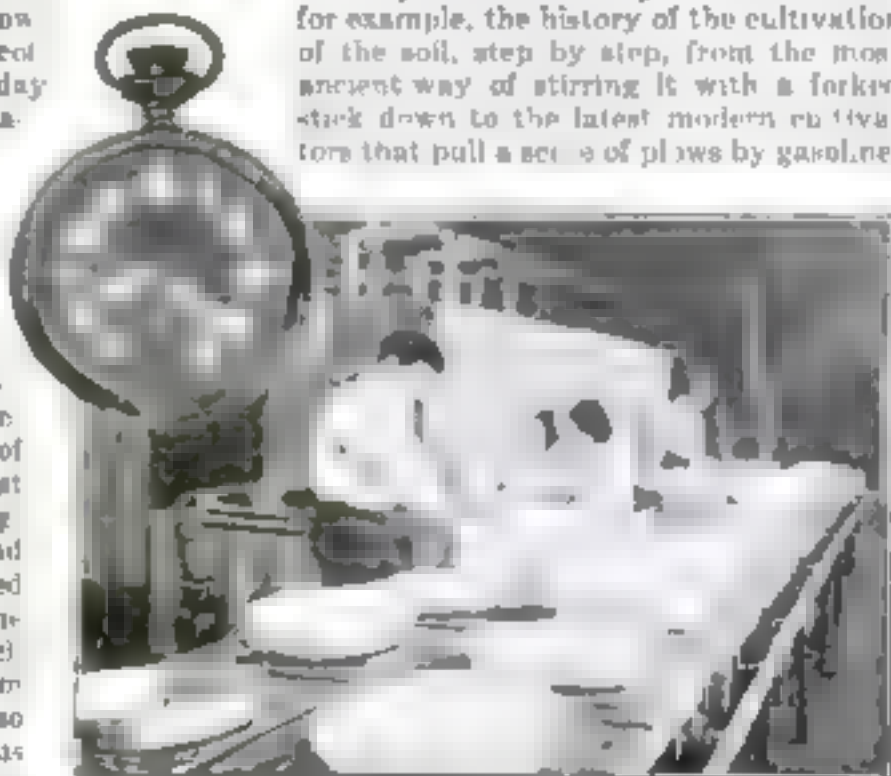
Life's Inventions

What is this but evolution? The ancient alms specks, you remember, at first were not able to move themselves about at all. Then presently they invented muscle fibers so that they could twist themselves through the water. Next they invented a stiff rod down the back so that the muscles could twist

them more violently and move them faster. They then began to swim like a fish. Gradually, invention by invention, they moved ashore and learned to creep and to walk. Some of them have even learned to fly.

How similar this is to the history of the human inventions that have given us our present means of transportation.

This universality of evolution is evident in every human activity. We can trace, for example, the history of the cultivation of the soil, step by step, from the most ancient way of stirring it with a forked stick down to the latest modern cultivators that pull a score of plows by gasoline.



RADIUM EVOLVES—How radium is prepared for many uses, including illumination of familiar radium watch faces (inset)

Courtesy E. S. Radium Co.

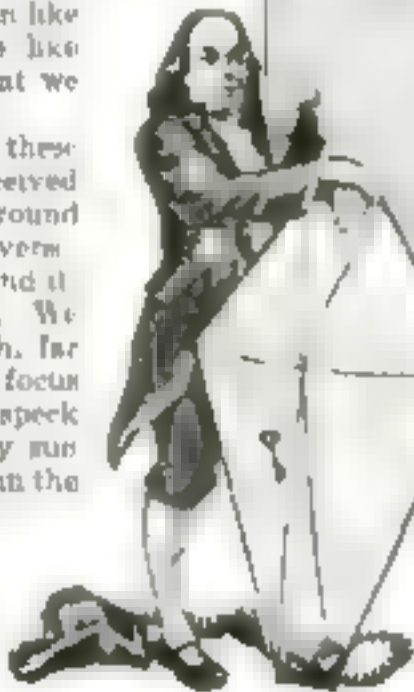
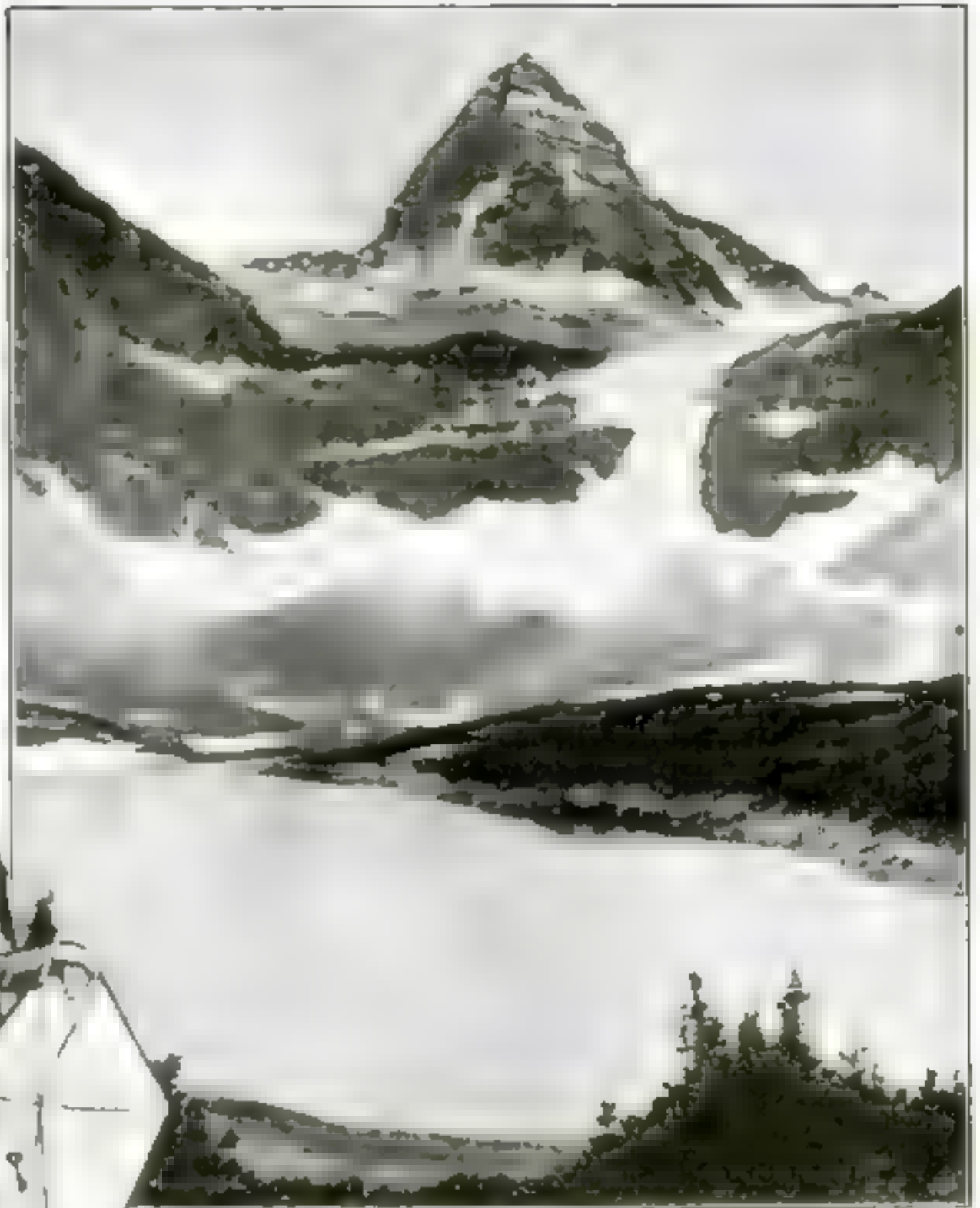
We can trace weapons of warfare in unbroken sequence from the hurled stone or swung club of the caveman to the poison gas and airplane bombs of modern destructive science. Even cookery is a traceable evolution from the ancient hot stone dropped into the stew with the bones. Fountain pens and fluid ink are direct descendants of the earth-smeared thumb of the prehistoric cave painter. We still have two buttons on the backs of evening coats because men used to wear a sword belt that had to be held up by an evolutionary vestige thus, quite comparable with the fact that we still have an appendix inside the human body.

Ideas Are Subject to Change

Nor is invention the only place where evolution is evident. Ideas, too, are subject to evolutionary change. Think, for example, of what men believed from age to age about the place and support of the earth in space. In the beginning they thought it was a flat thing like a saucer floating in a universal sea of water. A few people, more curious or imaginative than the rest, asked themselves what the water was resting on and found no answer except the mythical ones of a great elephant or a broadbacked turtle or some gigantic strong man like Atlas. On some creature like this the whole universe that we know was supposed to rest.

But as time went on, these ideas changed. Men perceived that the earth was really a round ball, the center of the universe. The heavens revolved around it. Then ideas changed again. We believe now that the earth, far from being the center and focus of everything, is but a tiny speck revolving around a mighty sun which is itself a mere speck in the inconceivable vastness of space. And that the evolution of these ideas is still going on, that what we think about space and about the nature of the universe is about to change again, is evidenced by the theories of Professor Einstein with which the scientists are now so much concerned.

Other examples of the evolution of ideas are visible in those that we call social customs. Consider table manners, for example. The cave man merely grabbed what he wanted, dipping his hairy fingers in the pot or snatching bones out of the fire. Even so recently as three or four centuries ago most of our ancestors ate from a common dish, slicing off with daggers such morsels of meat as struck their fancy. Evolution has been much at work since then, and lest you



IF YOU COULD LIVE A MILLION YEARS you would see this mountain not as it is, but as it was a million years ago. Not only the very earth itself but the laws of nature which govern it are in evolution. Compare the modern scenery of the Alps with the ancient Eifel and you will see the difference from the mountains growing into a world of a half age of scientific marvels.

think these matters of social custom unimportant in world history, remember that few crimes are punished so unfailingly or promptly, either by business or by society, as crimes against custom, the crimes, for example, of guzzling coffee from a saucer or of eating with your knife.

It is not in the least an exaggeration to say that if one is unable to acquire such table manners as one's social surroundings demand, this may be an even larger factor in the prosperity of the individual

and in the survival of his offspring than was a weak backbone to a creature in the stage of evolution between the worm and fish or an un-sure eye to the monkey who was on the way toward an ape.

It is quite possible that the scientists of 10,000 or 20,000 years

from now, when they come to look back on the 10 centuries of the millennium in which we are now living, will hold its most important evolutionary event to have been the growth of those social ideas and customs that scientifically we describe as humanitarianism but which find their real and everyday expression in what we call politeness. *(Continued on page 140)*



THE EVOLUTION OF TRANSPORTATION is strikingly illustrated by this comparison of the ancient ox cart with the modern motor car.

Beginning Next Month

The Story of the Mind

Most fascinating and useful psychological series ever published in a magazine

By James J. Walsh, M.D.

Famous American surgeon and psychologist

Read his preface on page 34 of this issue

Seashell Makes Effective Loudspeaker Horn

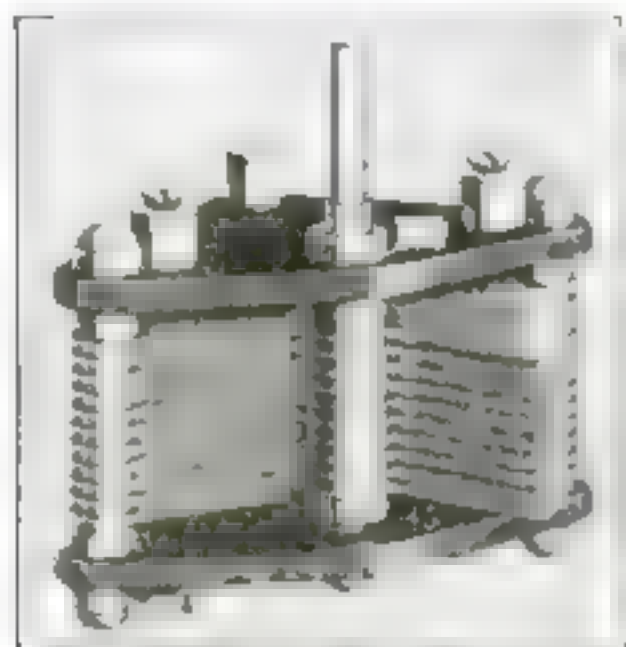
DESIGNERS of radio apparatus, seeking a form of loudspeaker horn that would be small, ornamental, and at the same time produce a large volume of



sound, are said to have received valuable suggestions from the accidental use of a seashell as a horn by a radio enthusiast in Atlantic City, N. J.

Desiring a loudspeaker for his portable set, but finding the horn too bulky, he attached the

shell to the loudspeaking telephone and was astonished by the result. Although the shell was only a few inches long, its peculiar shape gave it acoustic properties that caused it to produce as loud and perfect tones as had been obtained from a larger horn.



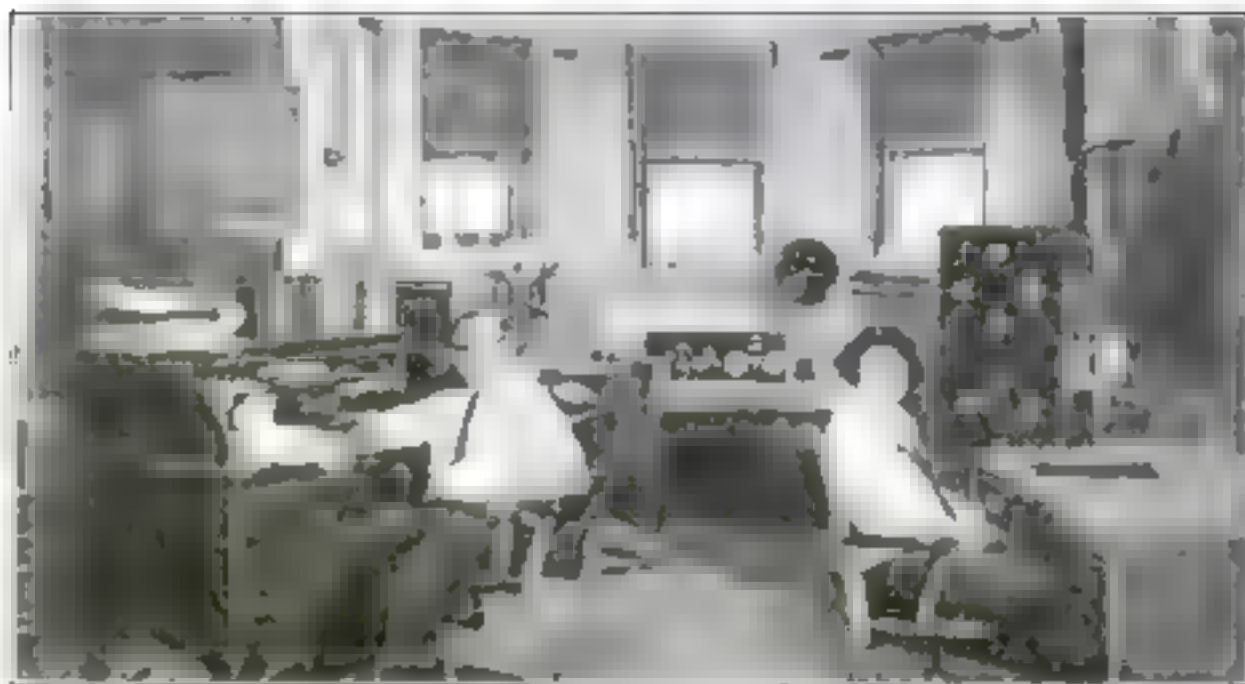
Remedies Inaccuracies of Variable Condenser

THE inaccuracy in the spacing of the plates common to many of the present forms of variable condensers has been remedied by one manufacturer by making the spacing collars of the condensers an integral part of the condenser plates. By this form of construction accurate assembly and rigidity are assured.

How to Avoid Grounding of Your Aerial

BEFORE you try your radio set, make sure that there is no chance of any part of your aerial being grounded by touching or swinging against any grounded object.

When no signals are received, the trouble may be due to the fact that the wire leading from the aerial to the set is touching the wire going from the set to the ground. To eliminate this trouble, use insulated wires for leads to and from the set.



Interior of the farm bureau radio broadcasting station at Centerville, Ia.

Farmers Own Broadcasting Station

FINDING the mails and the telephone too slow in distributing daily market information, progressive farmers of Appanoose County, Ia., have established the first radio broadcasting station to be operated by a farm bureau organization in the United States. The station, located at Centerville, and known as XYZ, is

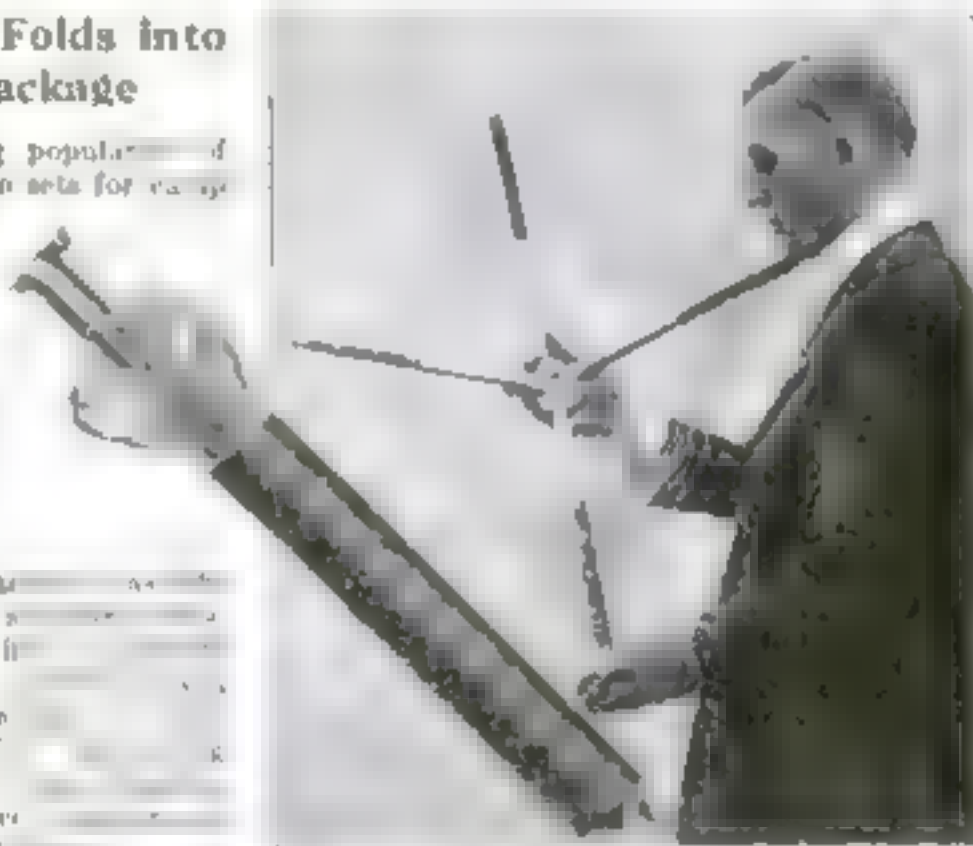
equipped with broadcasting and receiving sets of the latest type.

More than 100 farmers' receiving sets in the county listen each noon to market figures, news, descriptions of new farm methods and entertainment. C. W. Clarke, county agent, reports the innovation an unqualified success.

Loop Aerial Folds into Neat Package

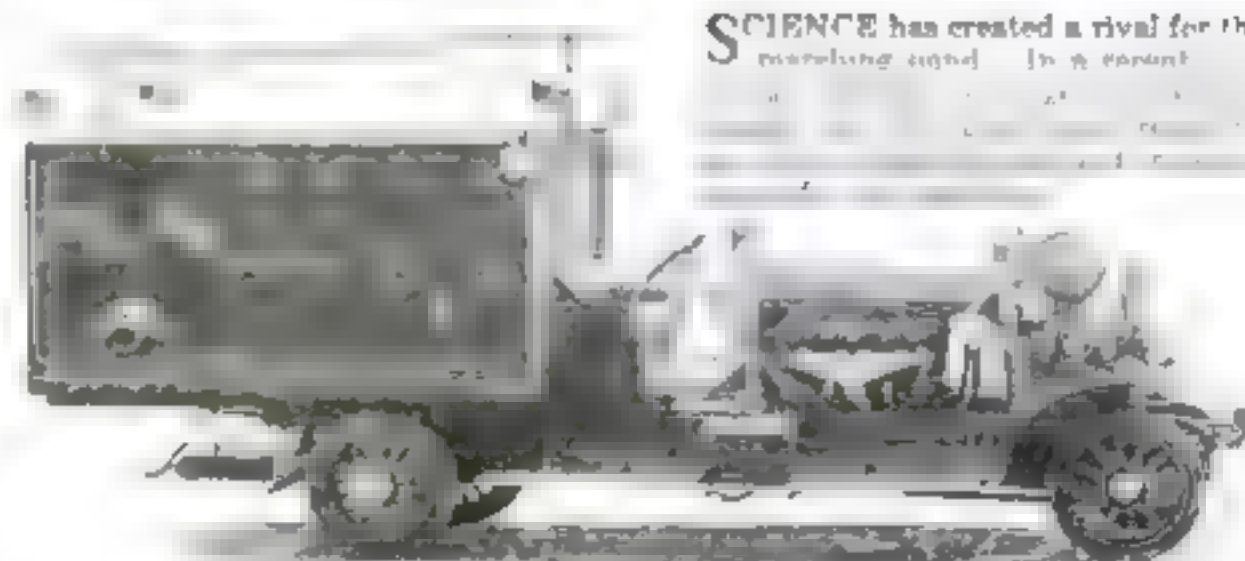
THE increasing popularity of portable radio sets for camp and touring use has brought forth many types of portable aerials. The most satisfactory of these is the loop aerial type that can be folded into a compact package.

Although this is as efficient as any of the others, it can be folded in slightly more than half, having a total weight of 2 1/2 pounds. The frame of the loop is made of wire, and the wires are looped and inserted in a



Truck Carries Radio Band in Parade

SCIENCE has created a rival for the traveling signal in a portable



Tuning Coils—the Nerve Centers of Radio Reception

Various Forms of Inductance and Their Advantages

By Jack Binns

Radio Editor of
POPULAR SCIENCE MONTHLY

THE most important rule for the radio fan to learn in building his own set is that in the reception of broadcast wave lengths inductance is more important than capacity. Since inductance is obtained from coils of wire, and capacity from condensers, it follows that he will have to use as much of his coil and as little of his condenser as possible.

For that reason I am devoting this month's article to a consideration of various forms of inductances and their uses in radio circuits.

Many Coil Types

The different types of coil in use are almost too numerous to mention in detail. Among them undoubtedly are still many of the old-fashioned single and double slide tuners. These invariably consist of a coil of enameled wire wound upon a tube of very large diameter. As a rule a brass rod is fastened above this coil and a brass slider so arranged that it will run along the rod from one end of the coil to the other, making contact with the coil wire along a strip where the insulation has been scraped away.

With such a coil simple vacuum tube circuits can be made without the use of a condenser, because in the inefficiently wound coil itself is considerable distributed capacity. The simplicity of this form of coil makes it an ideal one for the beginner. Its disadvantages include its excessive amount of distributed capacity and the general inefficiency of the winding and contacting.

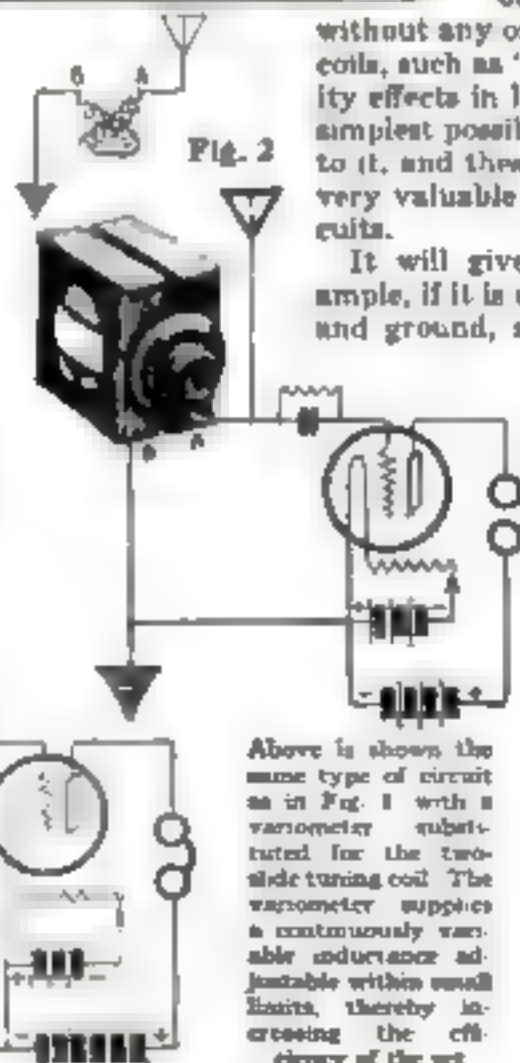
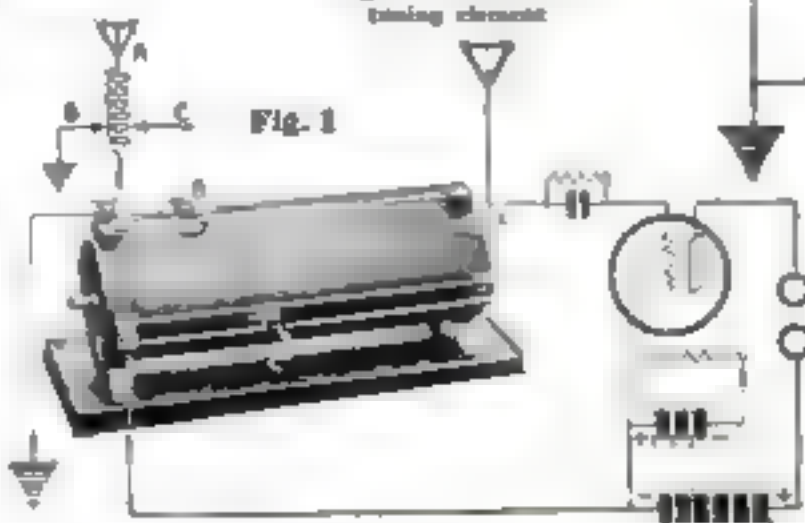
The simplest form of circuit with such a tuner can be made by joining the aerial to the active end of the coil, and a ground wire to the slider. The vacuum tube will be joined to an A and B battery in the usual manner. A wire should be carried from the aerial side of the tuner to the grid condenser, and another wire from the positive side of the A battery to



ACCOMPANYING RADIO

Using her piano wires as an aerial Miss Frances Mayer of New York City easily brings in broadcast radio music which she accompanies on her piano. Careful tuning of her radio set and skill as a pianist are required for this unusual feat.

The wiring diagram in Fig. 1 (below) shows one of the most elementary forms of a conductively coupled double-circuit vacuum tube receiver using a two-slide coil as a tuning element.



Above is shown the same type of circuit as in Fig. 1 with a variometer substituted for the two-slide tuning coil. The variometer supplies a continuously variable inductance adjustable within small limits, thereby increasing the efficiency of the set.

the ground terminal. Tuning then is accomplished by running the slider up and down the coil until the required number of turns are obtained.

A variation of this form of tuner is a similar coil with two sliders attached, as shown in Fig. 1. The addition of the second slider converts the coil into an auto transformer, making possible the construction of a double circuit. The connections in this case will be the same as above, with one exception. Instead of carrying the lead from the positive side of the A battery to the ground, it will go to the second slider. Such a coil allows slightly greater selectivity than the single slide tuner.

Slide or Switch

In these tuners the brass slide takes the place of the switch in the variometer. The object is to bring into action a definite number of turns of wire.

Probably the most efficient instrument ever devised for varying inductance is the variometer.

The advantage of the variometer lies in the fact that it affords a means of continuously varying inductance without any of the losses that affect other coils, such as 'dead-end' losses, or capacity effects in leads to switch points. The simplest possible connections can be made to it, and these can be extremely short, a very valuable factor in vacuum tube circuits.

It will give excellent results, for example, if it is connected between an aerial and ground, as shown in Fig. 2, with a vacuum tube connected with it in the manner I have described for the single slide tuning coil.

For fine tuning of inductance, the variometer cannot be surpassed. Its disadvantages are the difficulty of winding it and the limitations of inductance changing range. In constructing the instrument, shellac never should be used to bind the coils in place, nor should the wire be wound on heavy formers. A fairly efficient variometer can be made with two honeycomb or dualateral coils con-

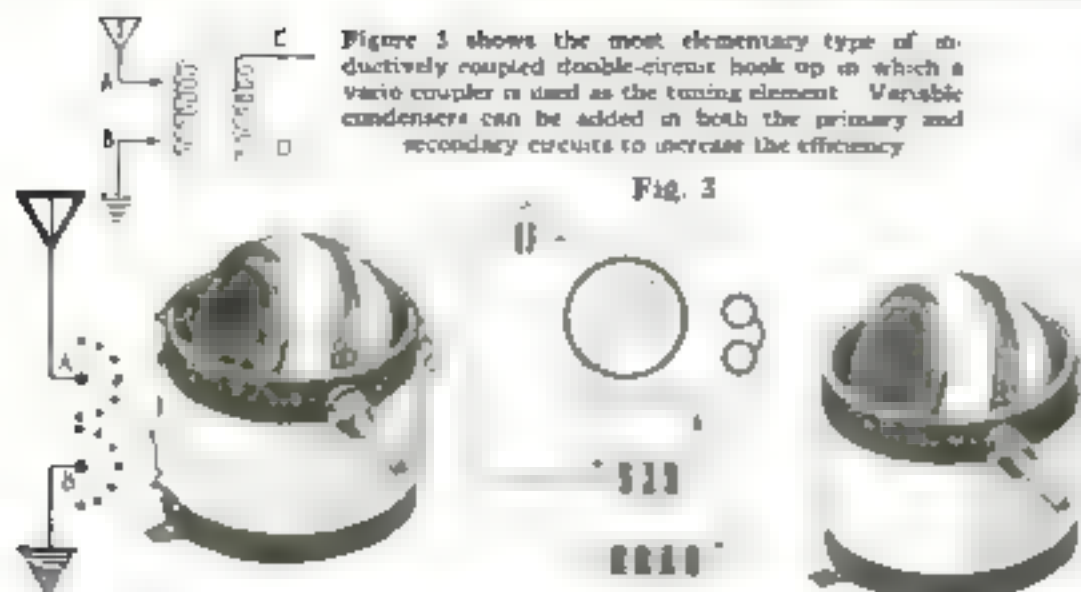


Figure 3 shows the most elementary type of inductively coupled double-circuit hook up in which a vario coupler is used as the tuning element. Variable condensers can be added in both the primary and secondary circuits to increase the efficiency.

Fig. 3

An elementary type of single-circuit regenerative receiver is shown in Fig. 4. The stator coil of the variocoupler is used as the coil common to both the primary and secondary circuits while the rotor coil connected into the plate circuit is used as the tickler coil to provide regeneration.

needed in series on a two-coil mount. Varying the coupling between two such coils will give a variometer effect.

As soon as the radio fan has mastered the single circuit, he will desire to proceed to a more selective receiver, which probably will be by means of a variocoupler. In simple double circuits, such as that shown in Fig. 3, where no condenser is used in the aerial circuit, it is imperative that two sets of switches be used, one for single turns, the other for groups of 10 turns.

With the variocoupler, much of the tuning is done by varying the coupling between the rotor and stator coils. It will be observed that in every case the inductance of the rotor coil is fixed so far as the number of turns of wire is concerned. In the case of the simple double circuit a variable condenser should be joined across the rotor coil in order to get the full amount of efficiency. In tuning, the smallest possible amount of the capacity of the condenser, consistent with good results, should be used.

Another Double Circuit Receiver

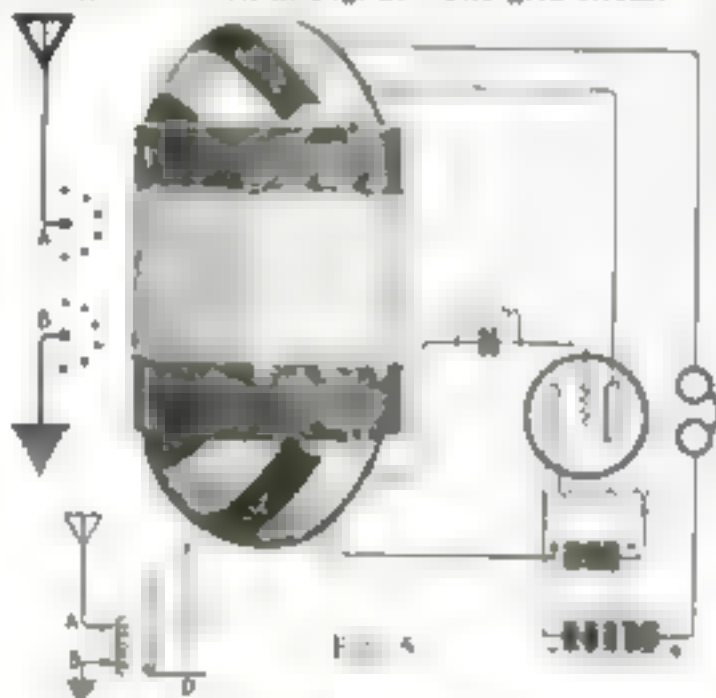
Another method of obtaining a double circuit receiver is by means of honeycomb or duolateral coils. In this case a two-coil mount is necessary, and two condensers are imperative. The condenser in the aerial circuit will be connected in series with the coil, while the condenser in the secondary circuit will be shunted across the coil.

The results to be obtained from regeneration are so advantageous that no fan will be content long to operate a straight non-regenerative receiver. In the case of regeneration, inductance is of extreme importance. There are two effective methods by which regeneration can be obtained first by electromagnetic coupling, and second by electrostatic coupling. Electromagnetic coupling is the most efficient and the most practical. It consists of feed-back action obtained through some form of coupled coils. Electrostatic coupling is obtained from capacity feed-back. To a certain extent, it can be obtained by the simple process of joining a variable condenser across the grid and plate terminals of the vacuum tube.

The simplest form of efficient regenerative circuit yet developed employs a variocoupler, as in Fig. 4, in such manner

that the rotor coil acts as the feed-back agency. In this case the tube can be set into a state of oscillation by increasing the degree of coupling between the two coils, provided the rotor has sufficient inductance in its turns.

The outside (or stator) coil of the variocoupler is connected with the aerial and ground in the manner described for the circuit shown in Fig. 3. The grid circuit



Here the actions and qualities of the circuits shown in Figs. 3 and 4 above are combined. The stator and lower rotor coil produce the circuit shown in Fig. 3 while the regenerative action described in Fig. 4 is produced by the upper rotor.

is connected with aerial and ground at both the switches, as in Fig. 4. The plate circuit runs from the plate of the tube through the rotor coil and the phones to the positive side of the B battery.

To many fans using honeycomb coils the idea of a regenerative receiver with only two such coils has not occurred. Yet such an arrangement is quite feasible. The advantage lies in the ease with which inductances are inserted in the circuit to meet any wave-length condition. Honeycomb coils have another great advantage, in the efficiency of their winding and design.

In the single-circuit re-

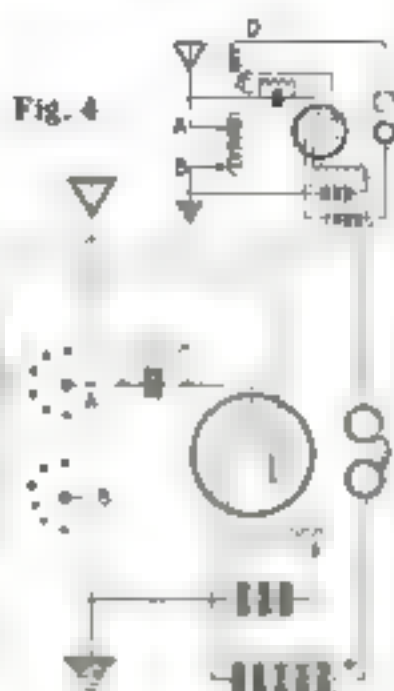


Fig. 4

generative set using the variocoupler, or in one using honeycomb coils, it may be necessary to reverse the connections with the tickler coil in order to get good results.

A variation of the variocoupler is a coil arrangement, somewhat resembling it, but with two rotor coils inside the outer tube, as shown in Fig. 5. Such an instrument permits the use of a double circuit receiver with regeneration. One of the rotors can be used as the secondary coil; the other as the tickler coil for regeneration. In this case it is best to connect a variable condenser across the

secondary coil. The condenser should be of as small a capacity as is practical.

Now we come to a method of obtaining regeneration that has found great favor with radio fans, and one that is very efficient on short wave reception—the so-called "tuned plate circuit." This circuit takes advantage of the internal capacity of the tube.

It has two main forms. One consists of a variocoupler with a condenser joined across its secondary, and a variometer in the plate circuit. The other has a variocoupler with a variometer in series with its secondary and another variometer in the plate circuit.

Three Tuned Circuits

In either form there are really three tuned circuits, each of which is placed in a condition of resonance with the incoming wave. The feed-back of energy between the plate and grid circuits is obtained from the capacity coupling existing between the grid and plate inside the tube.

IN NEXT month's article Jack Binns will tell of important new developments in the super-heterodyne receiver, popularly known as the "Rolls-Royce of radio."

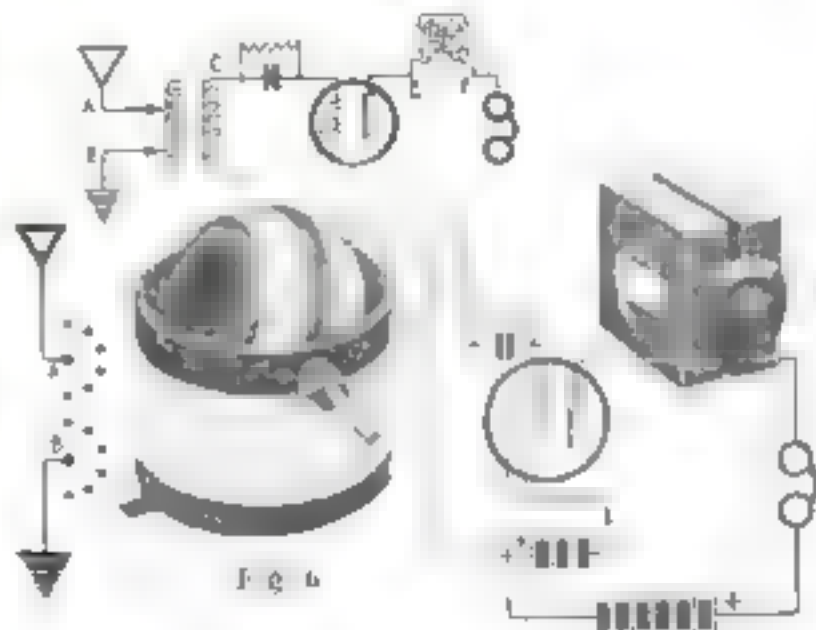


Fig. 6

Original form of the Armstrong tuned plate circuit type of regenerative receiver. The circuit is the same as that shown in Fig. 3, with the addition of a variometer in the plate circuit. This produces regeneration by tuning the plate circuit into resonance with the grid circuit.

Odd Ways to Make a Living

Colored feathers are tied to a fishhook to imitate a living fly. Much skill is required to select and shape the feathers

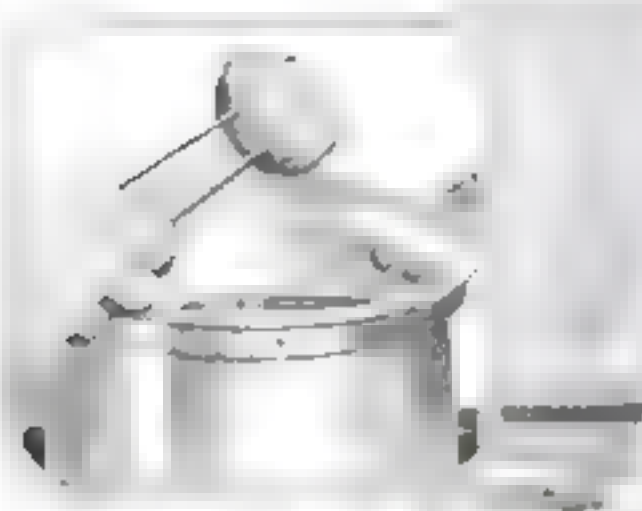
LIFELIKE FLIES, with steel fish hooks for backbones, are created with astonishing skill by Mr and Mrs. J. H. Hornfeldt, of Ridgewood, N. J. They are shown above in their workshop, fashioning feathers to supply expert anglers with the indispensable lures

CROWS AND BLACKBIRDS ARE DOOMED at the Experimental Farm of the U. S. Department of Agriculture, Arlington, Va. There the oldtime scarecrow has been supplanted by "Dad" Garrett, who in spite of his 80 summers, is a crack shot. "Dad" is shown at the left preparing to bring down one of the winged pests with his gun

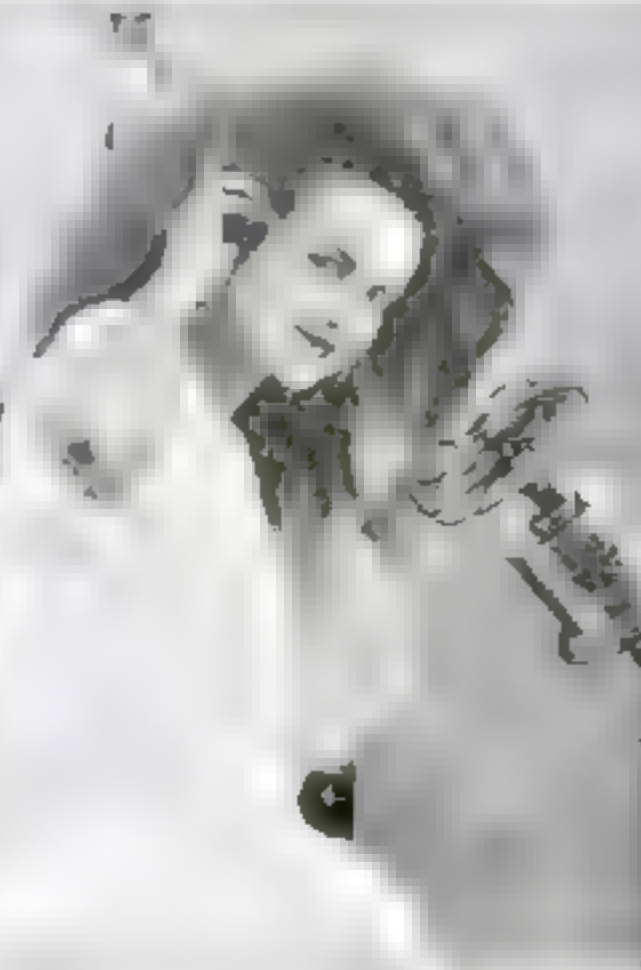
AN ARTIST IN GLASS is Herman Miller, who makes lifelike glass models of strange undersea animals for the American Museum of Natural History in New York. He is shown above inserting minute glass feelers in rotifers. By these feelers or suckers, the strange, leechlike creatures attach themselves to marine plants

PAINTING TINY INSECTS. Miss Eleanor T. Armstrong carries on a strange profession in the National Museum at Washington, D. C. Her subjects "sit" for her under the microscope

Better Methods for the Housewife



Taste vegetables after washing them in water. The water is then poured off and the vegetables are ready to be cooked.



Stirring sticks for food cookers that catch on pots can be replaced by the new sticks that will not catch on the pot by overhanging the pot and the stick can be forced away.



An all the latest electrical equipment for the home is a wall switch. It is a simple device that can be used to control the lights in the room. It is a simple device that can be used to control the lights in the room.



The new electric motor for the home is a simple device that can be used to control the lights in the room. It is a simple device that can be used to control the lights in the room.



The new electric motor for the home is a simple device that can be used to control the lights in the room. It is a simple device that can be used to control the lights in the room.



Pressing a button starts an electric motor that spurts water over the dishes from a revolving metal cone.



An unbreakable metal top for percolators is said to improve the coffee.



This unique four-story cooker utilizes heat usually wasted. Each of the four pots heats the next above.

Coal or Oil Fuel—Which?

A Few Pointers about the Heating Problem in Your Home

By Collins P. Biles

Professor of Mechanical Engineering,
New York University

Houses that today require the services of a man to remove ashes can save the cost of his labor by installing an oil burner.

A good oil burner, properly installed, can be operated just as cheaply as a coal furnace. From 140 to 150 gallons of oil in actual use are required to give heat equivalent to that produced by a ton of coal. At 9½ cents a gallon this is equivalent to about \$14 a ton. With coal at about \$1.6 a ton at present, it is apparent that oil is cheaper.

A FIFTY CENT broom will sweep a room just as clean as will a \$50 vacuum cleaner, yet housewives are using brooms less and less. The reason is obvious. A vacuum cleaner stirs up less dust; it does the work in vastly less time; it is operated easily and it leaves no pile of sweepings to be gathered up.

The comparison between domestic coal furnaces and modern oil burners is very similar. Where oil fuel is used, no clouds of dust come up from the cellar to injure health; a supply of heat is obtained easily and maintained evenly with little trouble, and the disagreeable job of cleaning out the ashes is eliminated.

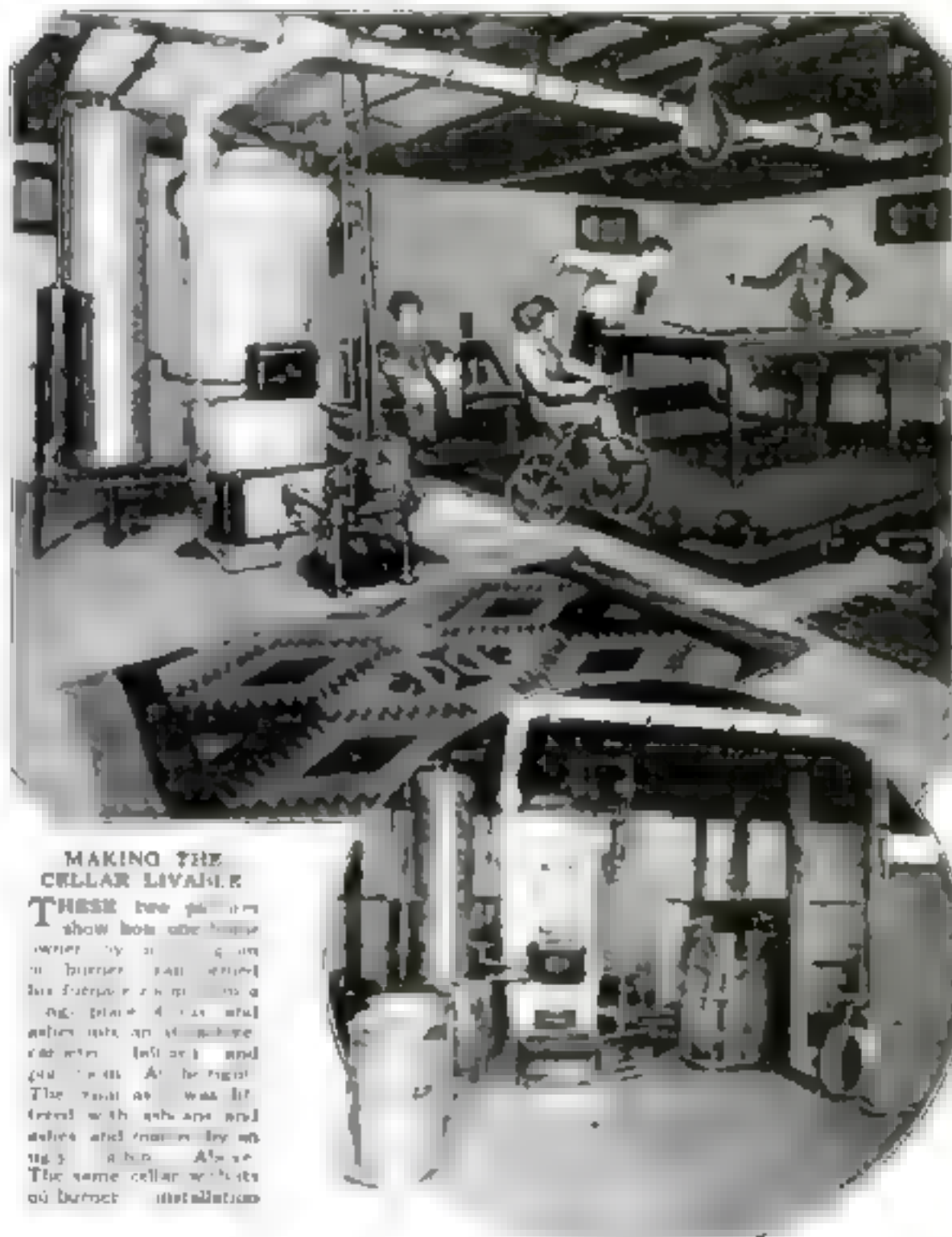
Oil as Fuel

The question often asked is, "Can I use oil satisfactorily as a fuel in my home?" You certainly can if the proper equipment is installed carefully. On the market today are many oil burners that will work equally well in a five-room home or a 25-room dwelling. On the other hand, there are burners that will not work at all successfully.

Burners that have been found to work satisfactorily appear at first to be very complex. Such parts as fans, motors, and thermostats give one the idea that they are difficult to operate. This impression is erroneous. The average woman thinks nothing of driving a car with mechanism more complex than that of the oil burner. The clutch, brake, gearshift, and other parts of the automobile are as nothing to her. Why should she not be able to handle an automatic oil burner just as easily?

Attempts to simplify oil burners have not, to my mind, proved successful. I believe that future development will be along the line of improving the present successful burners equipped with positive fuel feeds and with automatic controls. The next few years will see a development in oil burners as remarkable as has been the development of automobiles since 1905.

"What advantage has an oil burner over coal?" is another question.



MAKING THE CELLAR LIVABLE
THESE two pictures show how the home owner, by installing an oil burner, can convert his furnace cellar into a bright place. At the left, when the cellar is filled with smoke and ashes, and the room above is filled with smoke and ashes. At the right, the same cellar with its oil burner installation.

One advantage is convenience. For example, a thermostat, located in the living room, registers the temperature in the house. When the temperature drops below a predetermined mark, an electric control is operated, the burner lights automatically and the furnace generates heat. Similarly, when the temperature is too high, the burner automatically shuts off. This automatic process continues day and night whether any one is in the house or not.

Oil Burner Saves Many Steps

Obviously there is no need of going into the cellar to shovel coal into the furnace every little while, nor is there tight banking of fires and a cold house in the

Then, too, there are no ashes. All the oil burns without soot or smell. The gases go up the chimney and no residue remains.

the grates of the coal furnace, insert the nose of the burner and fasten it in place. A careful survey should be made to see that there are enough radiators or registers to give heating surface sufficient to heat the house. At the same time the most advantageous location for the thermostat should be determined. This is important because a direct draft of cold air or direct heat from any source will cause the thermostat to register falsely.

Another question often asked is, "What type of oil burner shall I buy?" As I said before, numerous types of oil burners are available; they fall under three general classifications: vaporizing, air atomizing, and steam atomizing burners.

In the vaporizing type, oil is fed by drops to a burning vat or bowl, lighted with a match. A jet of air produced by the chimney draft impinges on the surface of the oil, supplying the oxygen for combustion. No attempt is made to mix

Installation Cost

Of course, the original investment with interest must be considered. A coal-burning furnace in a seven-room house can be transformed to an automatic oil-burning furnace for from about \$600 to \$800. Yet the saving in fuel over a period of years will go a long way toward paying the principal and interest of this investment. Then, too, it is not unreasonable to assume that coal prices will continue to mount as in the past and that they may climb soon toward \$20 a ton. At such a figure it is absolutely certain that oil would be the more economical fuel.

To install an oil burner all that is necessary is to remove

the oil in small atomized particles with the air before combustion. The result is that much carbon often forms, causing large chimney losses and a poor transfer of heat. While these burners will work well in places where the natural draft is good, they cannot without previous test be applied successfully to every type of house furnace.

The air-atomizing type utilizes the principle that air and minute particles of oil form a highly combustible mixture. The air is provided either by means of electric fans or an air compressor. The air is shot from a nozzle at great speed, sucking oil from another nozzle close by. The oil is broken up into small particles and the mixture is ignited, either by a gas pilot light or by an electric spark plug.

Observe These Points

The steam atomizing type follows the same principle, but uses superheated steam as the carrying agent.

"Which type and which particular burner should be selected?" is the final question to be answered. Since there are a number of different burners that will work well, it is well to observe the following points:

1. There should be a positive air supply, provided by compressed air, fan, or steam.

2. There should be a dependable source of power control for auxiliaries, such as gas or electricity.

3. There should be automatic controls to start and stop the flame.

4. Oil and air feeds should be easily adjustable.

5. The burner must fit the furnace. A big burner in a small furnace will only

from the particular burner you are considering. A coal fire needs less chimney area.

7. The flames from the burner must not strike an unprotected surface and so burn out the boiler flues, tubes, or other parts.

The oil burning system includes two tanks, the burner, piping, and electric wiring. A large storage tank varying in capacity from about 200 to 1150 gallons, is buried outside the house. City ordinances require adequate protection of this tank. Some localities require a one half to one foot coating of concrete. In other places a covering of sand and a slab of concrete are deemed sufficient. Before purchasing a burner it is well to investigate the local ordinances regarding the installation of furnaces.

For Oil Storage

Oil from the buried tank is led to a smaller tank of about 60 gallons in the cellar. Here again some city ordinances require that the oil be pumped into the cellar instead of using gravity.

Many ships long ago discarded their coal bunkers and substituted oil tanks. Then factories, large office buildings, and apartment houses fell in line. Thousands of such installations are now in operation. In all these plants, the boiler rooms look as spick and

span as hospital operating rooms. It is only a question of time when oil will replace coal in many homes also.



Typical installation of an oil-burner system, showing location of oil

How to Insure against Danger

IN THE use of oil as a heating fuel in your home, a few simple precautions are offered by experts, as follows:

1. Be sure the apparatus is installed in accordance with regulations of fire underwriters and city ordinances.

2. Inspect the system daily. If a pilot light is used, see that the tip is free from carbon. Never use a naked light in hunting for leaks.

3. Before starting the burner, be sure all flues are clean and dampers are open wide.

4. Keep the furnace room free of papers, rags, and other rubbish.

5. Don't allow unignited oil to spray or drip from the burner into the furnace.

6. Don't allow any person to experiment with the apparatus.

7. Have the entire system thoroughly overhauled at the beginning of each heating season, preferably by the company that installed the burner.

waste fuel and in time injure the furnace.

6. The chimney of your house should be large enough to take away the gases

Storm Sash Opens when Window Is Raised

LIFTING a window, if it is equipped with the clever device shown here, simultaneously lifts the storm sash, thus eliminating the extra effort usually required to raise and fasten the storm sash independently.

The secret of the device lies in two lifting arms fastened to the inner sash and extending to the storm sash. The outer ends of the arms are fitted with roller bearings that run on tracks attached to the side members of the storm sash. Thus, as the inner window is raised, the storm window swings out.



How the storm sash is swung open by window



Six-Story Building Moved by Six Horses

SIX Los Angeles homes recently accomplished the astonishing feat of moving a six-story brick building, weighing 11,000 tons, for a distance of 125 feet. They did it with the aid of a series of tracks over which the structure moved on rollers.

The building housed a hotel which had to be moved from a site purchased by Los Angeles for municipal buildings.

Nineteen double tracks, a total length of a mile, were used. Forty-five lines of

cable, totaling 8100 feet, and three capstans conveyed the power supplied by the horses. The cable, tracks, and capstans were so arranged that the six horses pulled with a strength equal to that of 5400 horses, a multiplication of 900. The moving was, of course, 900 times slower than it would have been with 5400 horses pulling.

Fourteen hundred jacks were used. The distance covered in any day was 40 feet.

How to Fix Your Plumbing

First Aid Methods Any Householder Can Use when Water Pipes Leak or Burst in Winter

By John H. Schalek, M. E.

TO MOST of us the plumbing systems in our homes are like our teeth—we do not realize that we have them until something goes wrong. Then, when something does go wrong, we are quite helpless. Even the handy man who does a little carpenter work and painting about his home and perhaps tinkers with his automobile rarely will attempt to repair his plumbing, simply because he thinks that plumbing work is difficult and mysterious, requiring a very special kind of skill and unusual and complicated tools.

This is not so. Nearly any man, with the common tools found in almost every household, and without special mechanical skill, can do his own plumbing repair jobs. Most of these are emergency jobs—such as mending leaks that develop suddenly, endangering valuable furniture, rugs, wallpaper, and other household possessions. Every man should know how to give first aid in such cases as these. It is no more sensible to permit a serious leak to ruin your house furnishings while you try to summon a plumber than it is to let blood flow from a cut in your hand while you wait for your doctor.

Turning Off the Water

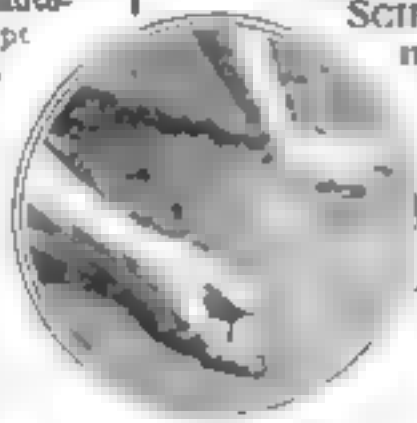
The first thing the amateur plumber should learn is how to turn off the water supply to the house. In many modern homes a shut-off valve, similar in appearance to the shut-off valve of a steam radiator, will be found beside the water meter.

If there is no shut-off valve in the house, the water supply may be turned off at the curb box. This box usually will be found near the street curb at the front of the house. If the position of this box is not known, often it may be located with the aid of an ordinary compass.

First find the place in the cellar where the water pipe enters; then, following the line of this pipe and holding the compass as close to the ground as possible, walk slowly to the curb. As you approach the iron curb box, the needle or disk of the compass will be deflected and it is then a simple matter to uncover the box and shut

YOU'LL be surprised as you read this article to discover that you don't need to be even a halfway mechanic—you hardly need to know one tool from another—in order to doctor the inevitable plumbing ills about your home. In simple terms an expert mechanic tells just how to do it quickly and effectively.

This is one of the most helpful of the articles appearing in POPULAR SCIENCE MONTHLY each month, telling the amateur how to do odd jobs around the house. You'll discover much real recreation and enjoyment in learning how to "fix it yourself."



Locating the curb box with a compass. The compass needle is deflected as you approach the iron box.

off the water with a key.

The water supply can be shut off from certain pipes by turning the valves found beneath sinks and wash-bowls, or in the cellar. If you do not know what pipes in your plumbing system these valves control, try the valves one after the other, and tag them against possible emergencies in the future.

Faucets and other valves that leak be-

Severed Pipes Easily Joined



Hammer each severed end over the union; join the half unions.

After cutting the broken pipe into two equal parts, join them with an ordinary half union. Then chip off the tongue of the union as shown above.



How three sections of pipe are joined tightly by ordinary pipe unions.



The first step in an emergency—turning off the water in the curb box. One full quarter turn shuts off the average cock.

cause the washer has become worn, waste an almost unbelievably large quantity of water. Leaking at the rate of only 10 drops a minute, the ordinary faucet will waste about 200 gallons of water in a year. Two leaking hot-water faucets will cost the householder at least a dollar a year in gas alone—enough to pay for 50 good washers.

To replace a faucet washer, first shut off the water from the house. Then close the faucet tight. Next unscrew the large nut connecting the handle with the body of the faucet. When this nut is free, unscrew the faucet by the handle.

If the Screw Is Corroded

When the core of the leaky faucet is out, look at the small screw that holds the washer in place. If the screw appears to be badly corroded so that it might break off when the screwdriver is used, cut the washer out with a sharp knife and take the screw out afterward, using pliers if necessary. Trim the new washer around the edges until it fits snugly into the recess in the core. Then replace the screw, screw in the core of the faucet as far as it will go, and tighten the large nut.

Leaks at pipe joints—joints where the pipe enters into couplings, unions, and other fittings—are due to strains or excessively worn threads. Unscrew the joint and smear a little thick paint, tar, or other heavy oil compound on the external thread—that is, the thread inserted in the joint.

If this should not stop the leak, coat the thread with a low melting point paste solder and heat with a flame until the solder has

melted, but do not permit the solder to fill up the threads.

It is well to have some litharge about the house. This is a yellowish powder that may be obtained at any hardware store. Mixed with boiled linseed oil, it forms a thick paste that can be used on pipe threads to make them tight.

Leaks in piping due to rust and freezing are repaired more easily than is generally imagined. When the emergency arises, two or more machinist's clamps, obtainable at hardware and often at five and ten cent stores, a piece of ordinary rubber gas tubing split longitudinally and a piece of heavy sheet iron will stop even very serious ruptures effectively. If the clamps are not available, an ordinary strap hinge and a large carriage bolt will prove effective.

An emergency leak clamp, successfully used by gas companies on gas lines holding more than 200 pounds pressure to the square inch, also has been used satisfactorily to stop water-pipe leaks.

Making the Emergency Clamp

All you need is a piece of wire, a piece of soft rubber, such as gas tubing, auto shoe, or inner tube, a piece of iron to act as a lever, and a piece of iron or wood, preferably in the shape of a wedge. The farther the wedge is driven in, the greater will become the pressure on the rubber packing.

A piece of rubber large enough to cover the burst section of the pipe and wrapped tightly on the pipe with heavy twine or wire also is a satisfactory way of repairing leaks temporarily.

Contrary to popular belief, it is impractical, if not impossible, to repair a leaking lead pipe by soldering. The pipe must be severed and rejoined. Since exceedingly skilful manipulation is required to cut the pipe at the point of leakage and wipe the joint, the following method will prove the simplest for the average man.

Cut the lead pipe with a saw. Select an ordinary pipe union large enough to allow the lead pipe to slip through readily. The tongue of the half union



This simple emergency leak clamp is made of a small stick, a wire, a stout wedge and a piece of rubber. Hammering the wedge toward the wire fulcrum brings pressure on the rubber covering the leak.



Two ways to stop a pipe leak temporarily. Above: A piece of rubber large enough to cover the burst section of the pipe is wrapped tightly with heavy twine or wire. At right: Ordinary gas tubing and a piece of heavy sheet iron are fastened about the broken pipe with machinist's clamps.

is chipped, sawed, or ground off. One severed end of the lead pipe then is inserted in the union and the end hammered over the union seat. The same operation then is performed on the other end of the pipe and half union. After both pipe ends have been fastened in the union halves, the ends are brought together and coupled by the union ring.

In cases where the rupture is large, so much of the lead pipe must be cut out that it will be found impossible to bring the ends together. In this case two unions are needed. A piece of lead or iron pipe of suitable length is inserted between the unions, bridging the gap between the pipe ends.

Unions of this size may be bought for about 50 cents each and a job for

Two Simple Ways to Mend Small Holes in a Boiler



Small holes in the boiler can be stopped either by inserting a tapered wooden plug or by fitting a stove bolt, as shown above.

which a plumber would charge \$10 actually can be done for less than one dollar and a half.

When a hot-water storage tank develops a leak, most householders consider it beyond repair. But a small hole can be stopped easily by driving a tapered plug of white pine or walnut into the hole. The writer knows of one case where a plug inserted three years ago is still doing service. The plug should have a very gradual taper with the entering end almost as sharp as a needle. It is driven in with a hammer after it has first been soaked in water and the projecting end cut off within half an inch from the tank surface.

Where the hole in the tank is one quarter inch in diameter or larger, a most effective and workmanlike repair job can be made by using a stove bolt, two inches or more in length, a nut, a rubber washer, and two iron washers. Split one of the iron washers with a cold chisel. Slip the head of the bolt through the hole. Now place the split washer over the bolt and slide the washer against the boiler. Holding the bolt end firmly in one hand, screw the washer in through the hole with the other.

Once the washer is inside the tank, the head of the bolt cannot be pulled out. All that is necessary then is to put the rubber and iron washers on the protruding bolt and screw the nut tight.

Cover All Exposed Pipes

Leaks resulting from the bursting of frozen pipes cause much plumbing trouble at this time of year. Water pipes should not run in exposed walls. If you have such pipes in your home and they are accessible, they should be wrapped with sheet wool of a thickness of not less than three inches. But the surest way of preventing pipes from freezing is by shutting off the water at night and at other times when the house is without heat. After the water is shut off, the pipes should be drained at faucets, drains and flushes. If the house is left vacant in the winter, about two quarts of kerosene should be poured into closet bowls and a pint into each sink, washbowl and bathtub to prevent the traps from freezing and bursting during the severe weather.

These are plumbing jobs that every man should be able to do. Performing such simple repair tasks yourself will save you money—not only in plumber's bills but in house furnishings that easily might be ruined even by a very small leak.



A split washer, screwed on through the leak hole, holds the head of the stove bolt inside the boiler so that it can't slip through.



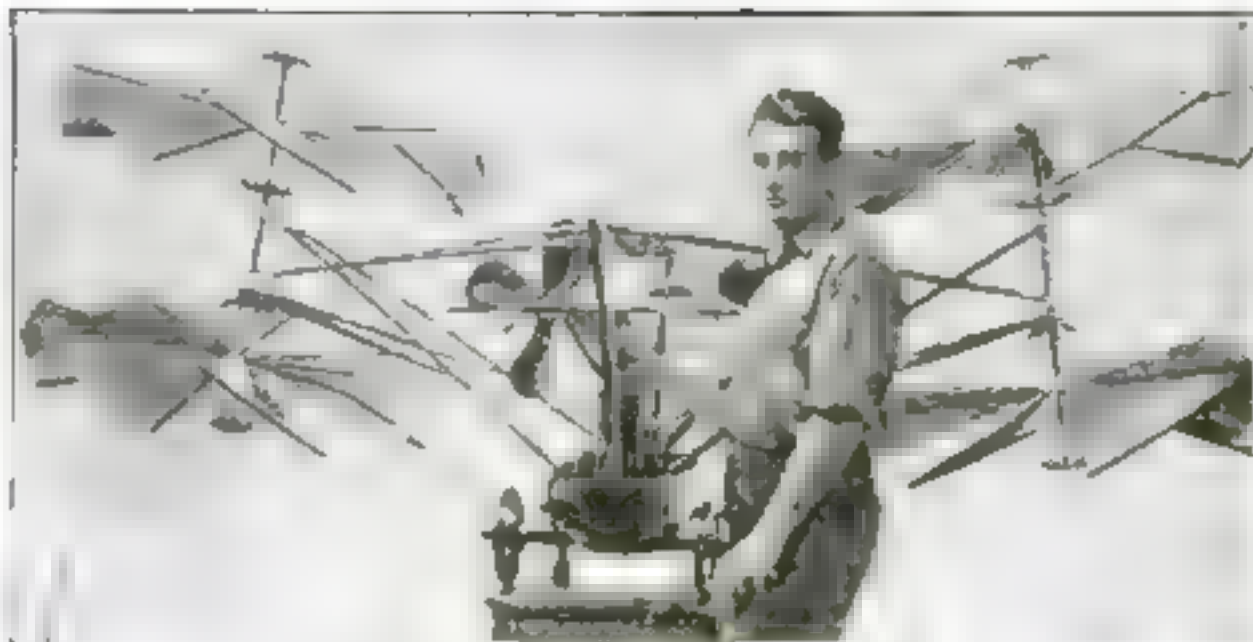
Parts of the stove bolt plug shown at the left—a split iron washer, rubber washer, split iron washer, bolt and nut.

Autos in China Must Wear Mud "Splashes"



ORDINARY mudfenders are not sufficient in China, for the law there requires that pedestrians, as well as a car and its occupants, be protected from the splashing of mud. Accordingly, all automobiles in China are

equipped with "splashes" on all four wheels. Each splasher consists of a strap-iron frame hung from the axle and encircling the wheel, from which hangs a heavy fringe of fiber or leather long enough to touch the ground.



Remodels Helicopter Invented 80 Years Ago

A MODEL of a helicopter from plans drawn in 1843 by Sir George Cayley was constructed recently by Paul Garber, custodian of airplane models in the Na-

tional Museum at Washington, D. C. The design, although conceived years before an airplane flew, is strikingly similar to those of recent helicopters.



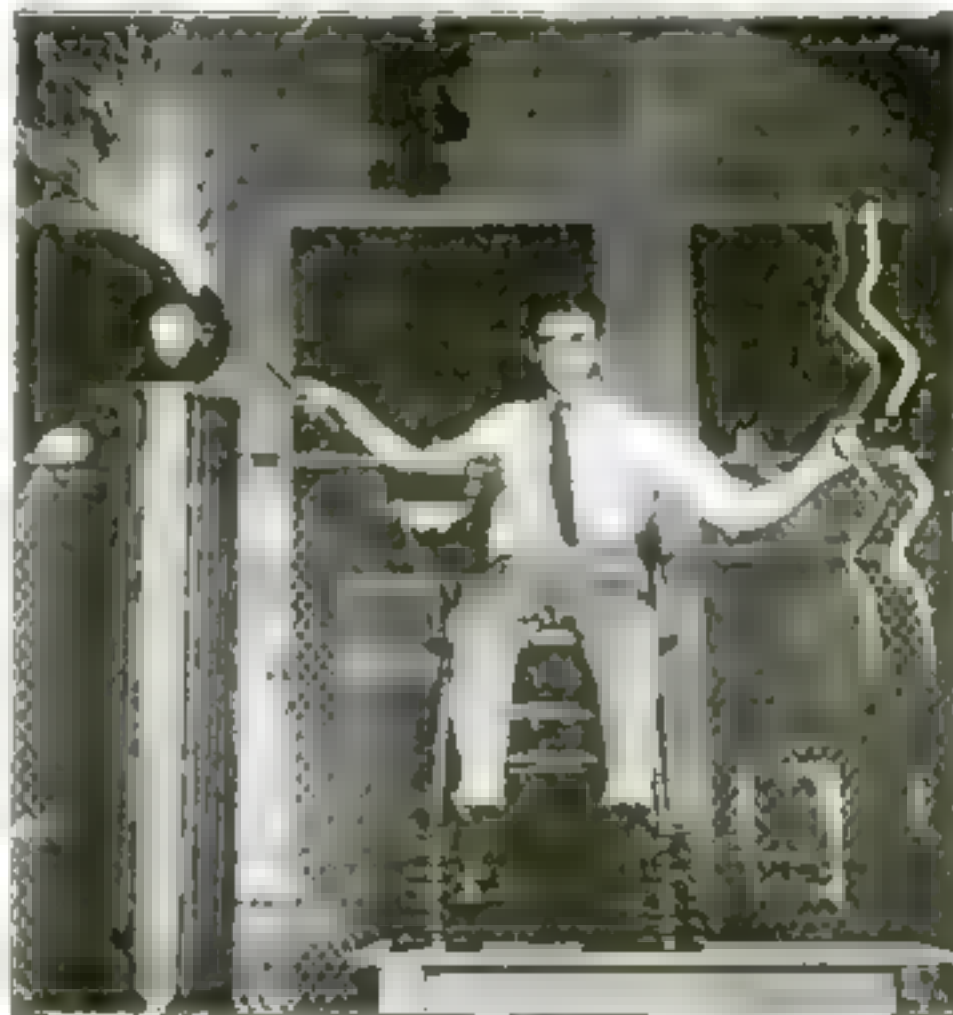
Broadcasting in the Jungle

THIS is a broadcasting station in the South American jungle—an amazingly noisy signal drum hollowed out of a log and used by the Turanos for maintaining communication when hunting.

Playing with Thunderbolt

THE scientific experiment of passing more than a million volts of electricity through one's body ordinarily would terminate one's scientific career. But Earl Holm, a senior at the University of California, Berkeley, Calif. here is shown performing that experiment with impunity, manufacturing thunderbolts as nonchalantly as might ancient Vulcan.

The secret of his apparent daring lies in septuple insulators on which the "operating" chair rests.



Strange Spider Monkey and Its Baby Captured



THIS spider monkey with her baby, which is said to be the only one in captivity, recently were presented to the San Diego, Calif., zoo by a detachment of United States marines stationed at Nicaragua. The spider monkey is so called on account of its extremely long, slender limbs and long tail. These are constantly employed in climbing.

This Pig Walks on 26 Toes

ON A Nebraska farm recently a pig with 26 toes was born, one of a litter of seven, the others being normal. Both front feet are double, and the left hind leg terminates in a veritable cluster of toes.



Reservoir Roofed like a Cathedral

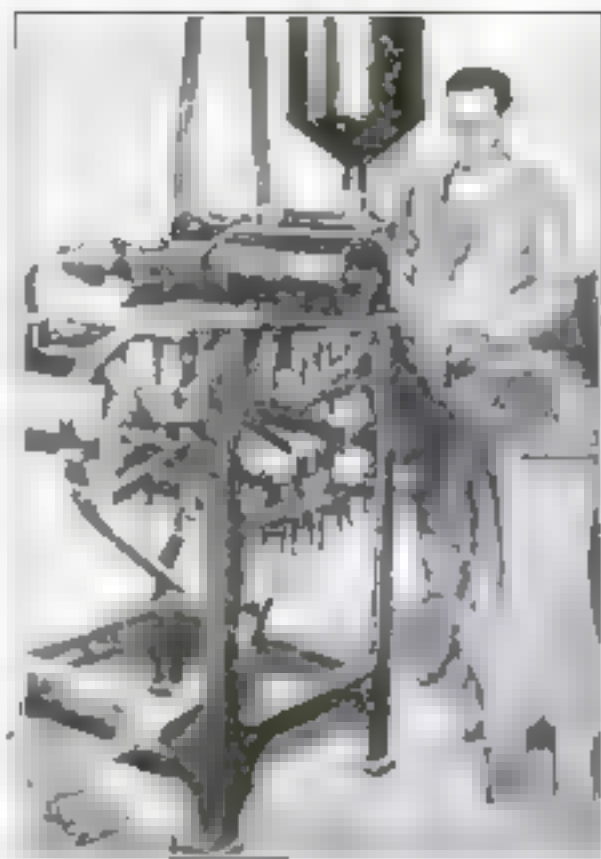


A forest of columns, 38 feet high, supports the enormous roof

THIS covered reservoir of reinforced concrete, an unusual piece of construction on account of the magnitude of its dimensions, was completed recently for the waterworks of Cleveland, Ohio.

Its enormous roof, approximately 1000 feet long and 500 feet wide, consists of groined-arch panels, supported by a forest of thick columns. Standing within the Baldwin Reservoir, one could readily imagine himself in a great cathedral.

The volume of concrete used in making the unit—walls, 1196 columns, 2206 groined-arch panels, and as many sections of floor slab—amounted to 104,100 cubic yds.

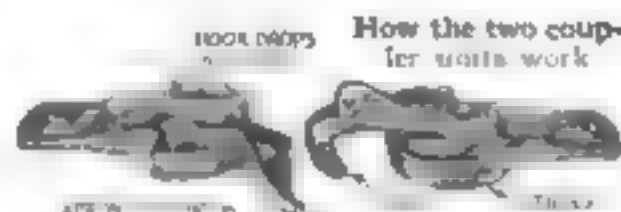


Toothpaste Tubes Filled by Machinery

HOW machinery puts toothpaste, cold cream, and shaving cream into the tubes is pictured above.

The empty tubes, in sockets, run on an endless band under a nozzle, where they are filled with the cream preparation drawn from a vat. After the filling, they are carried to a sealer that clamps together the open ends, bends them over, and stamps them into a tight seal. The tubes are held in place by the semi-circular metal strip shown at the left until they are directly above a chute, which conveys them to a packing box.

Automatic Car Coupler Saves Injury to Crew



AN AUTOMATIC safety coupler for mine cars has been perfected to lessen the number of casualties caused by the crushing of hands and bodies of workmen in making up trains of cars and later in uncoupling them.

The coupler is made in two sections, one fitting on the rear of the car and the other on the front. When two cars thus fitted are rammed together, an apron on one section of the coupler raises a hook on the other. This hook immediately drops into a slot in the first apron.

Sufficient play is allowed in the hook connection to prevent breaking of the coupler due to impact when the train is started with a jerk.

When soft coal is burned in the furnace, soot can be removed quickly and easily from flues and heating surfaces by throwing a pound of common salt, thoroughly dried, on the burning fuel bed. Immediately upon charging with salt the furnace becomes filled with dense, white fumes.

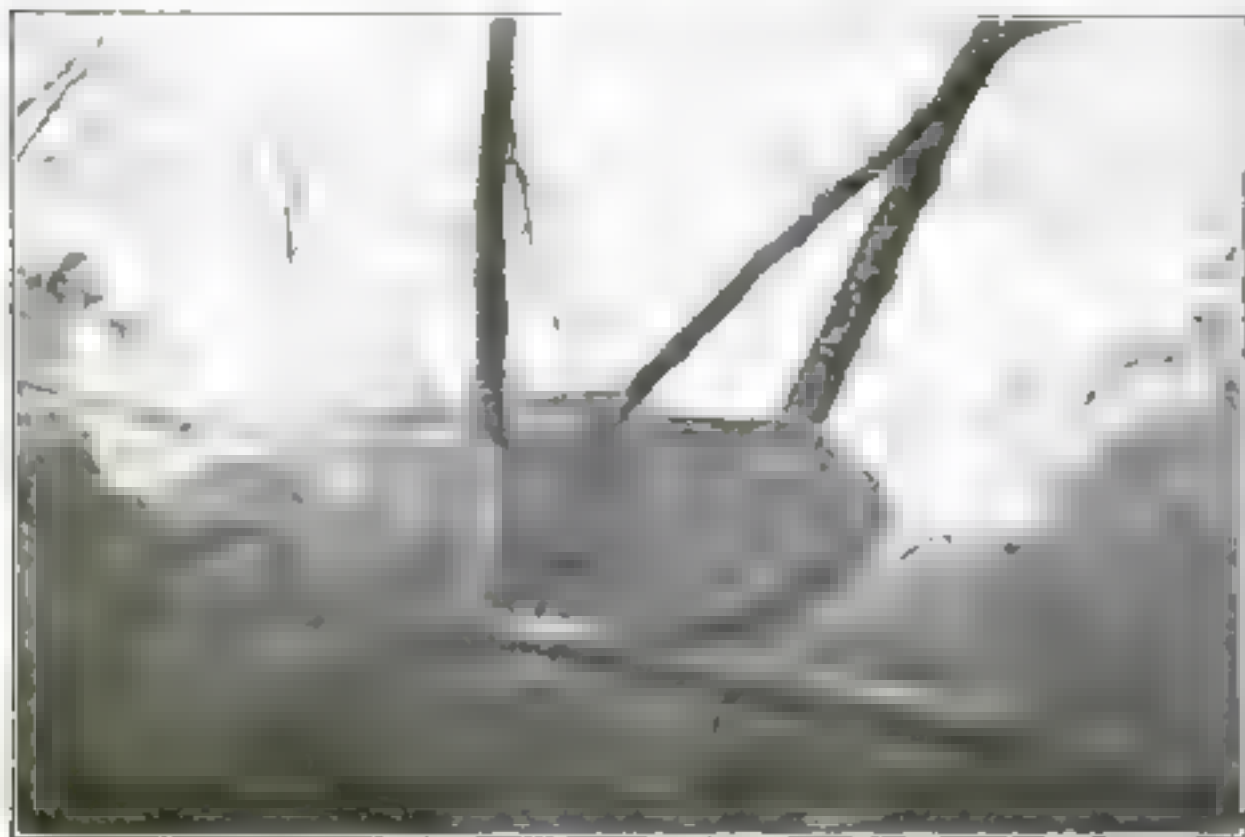
Uncle Sam Builds Huge Army Tanks

TANKS with many times the terrible destructive force of those that proved so deadly in the closing months of the Great War are being developed in experiments at Camp Meade. The illustration shows a lately evolved model splintering trees on the testing ground.

Not all of the experimental work is with fighting tanks. Tanks that can transport large guns, ammunition, infantry, signal apparatus, construction material, safely and rapidly for miles over

ground deeply pitted with shell holes and blocked by obstructions are vital to the success of the terrible fighting tank.

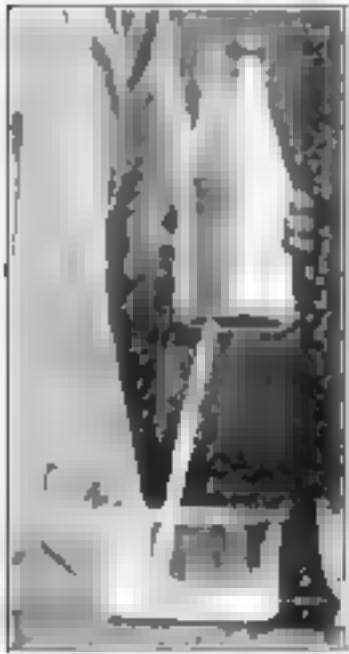
"BALSAM wool," a new heat insulator and sound-deadening material for buildings, excelled only by human hair and sheep's wool in insulating efficiency, is prepared from pulp, wood bark, and sulphite screenings. It is flexible and resistant to fire and water. It weighs only 255 pounds to 1000 square feet.



Testing one of the huge new army tanks over rough country

This Milk Bottle Uncorks at the Bottom

A MILK bottle that uncorks at the bottom, making it possible to draw off the milk while retaining the cream in the bottle, has been invented by Ray Dunn, of Tipton, Ia.



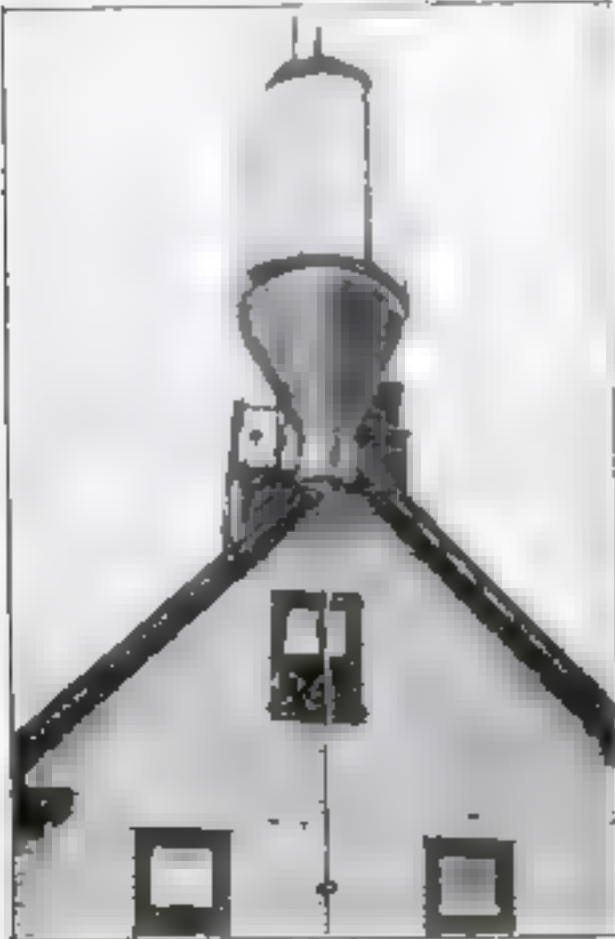
The bottle has a small opening at one edge of its bottom surface. This opening normally is closed by a cork to which is attached a cord or tassel. When the cork is pulled out, the milk will flow from the bottom of the bottle, thus

making it easy to empty and solving the problem of separating the milk from the cream.

The hole also assists in cleaning the bottle, which is filled in the usual way.

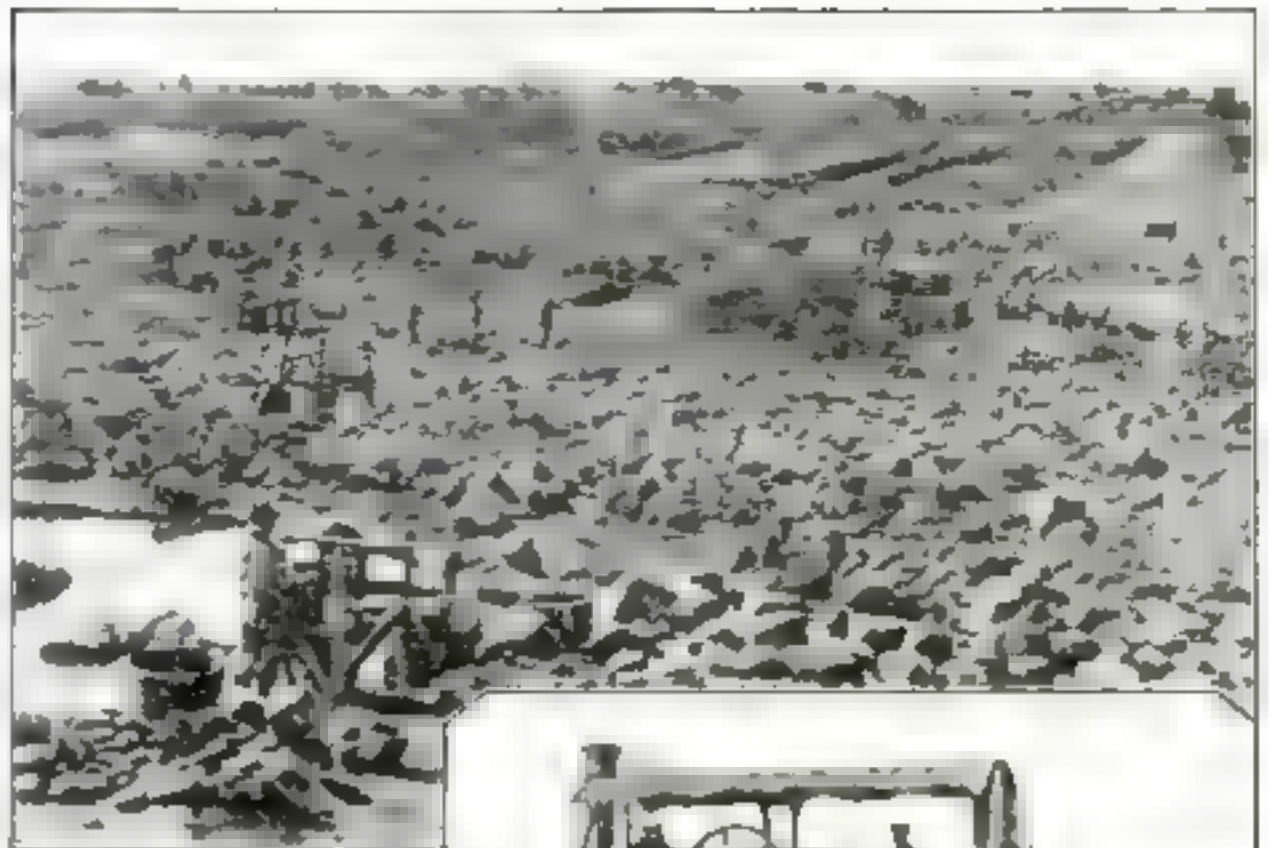
TO MAKE sure that a ring or other piece of jewelry is gold, drop it in nitric acid. Neither gold nor any precious stone will be harmed. The acid quickly attacks imitations, whether they be of precious stones or of gold.

Windmill Supplies Light

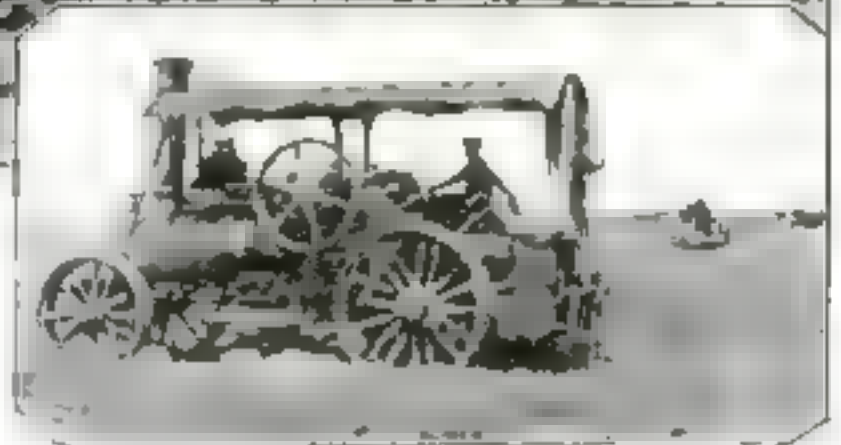


BY INSTALLING a windmill on his roof, a resident of East Cleveland, Ohio, lights his home almost without cost.

The windmill consists of eight perpendicular "sails" attached at top and bottom to circular, revolving frames. These are connected with a special one-kilowatt generator. The windmill is about 15 feet high and 50 feet above the ground.



Above: A diamond-bearing river bed exposed by diverting the stream from its bed. At the right: A tractor crushing clods in a blanket of blue clay from the mines to expose the gems for gathering.



How Kimberley Diamonds Are Mined

TWO methods by which the diamond, king of gems, is thieves from Nature's treasure chests are revealed by the illustrations above, showing scenes in the famous Kimberley district in British South Africa.

The larger picture shows a diamond-bearing river bed exposed by diverting the stream. Such streams carry diamonds down their course much as many Western streams in the United States bear down nuggets. Claims are staked out in the dried bed, 50 per cent of the value of the discoveries going to the Government

and 50 per cent to the claim holder. As in placer mining, virtually no digging is necessary, many of the stones lying on the surface.

The smaller picture shows a tractor crushing clods in a blanket of blue clay that has been brought up from the diamond mines and spread over the ground. This clay lies weathering for a year, during which it is plowed and smashed frequently. The conditioned clay then is taken to a separating mill.

Barbed wire charged with a deadly electric voltage guards the field.

Manufacturing Lightning in Movies

THIS machine produces flashes of lightning for moving pictures. The flashes are quite harmless, but are realistic enough to be terrifying when viewed on the screen.

The apparatus, which is of wood, is wired like a street arc lamp, except that several carbons are used instead of only two. About a half dozen of these are fastened to an upright arm and a single large carbon to a projecting arm. The latter can be moved back and forth by the attached rope.

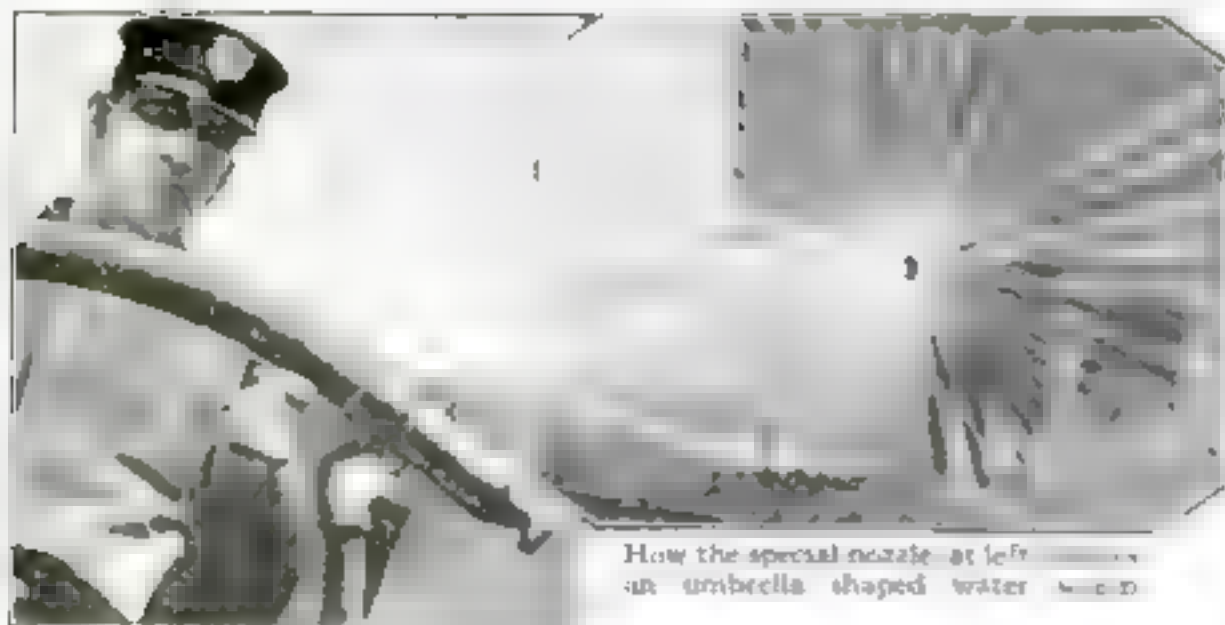
When the single carbon is brought in contact with the group, a great

flash of light is produced, registering with spectacular effect on the moving picture film.



The arc light machine that produces dazzling lightning flashes.

© Keystone



How the special nozzle at left throws an umbrella shaped water screen.

Nozzle Throws Water Barrage for Firemen

A UNIQUE type of fire hose nozzle, which, in addition to throwing a stream on a fire also supplies a curtain barrage of water to protect firemen from the heat, has been developed by a San Francisco concern.

A recent demonstration proved that the umbrella-shaped screen of water nullified the effect of the heat sufficiently

to permit firemen to insert the nozzle into a tank of burning gasoline. Also, the protecting stream, by cutting off the supply of oxygen from the fire, caused it to be extinguished almost instantly, a thing it would have been difficult to accomplish with the ordinary solid stream.

Using this nozzle, one man can handle a line carrying 150 pounds pressure

Springs to Heat Iceland

ICELAND is planning to utilize its natural hot springs and geysers in place of coal to heat the whole country, according to reports from Bergen, Norway. Preliminary plans call for wooden pipe lines to carry the hot water from the springs to the cities.

Rocker Quickly Converted into Wheel Chair

CONVERSION of a rocker into a wheel chair is accomplished in a few minutes by clamping to its base the special set of four wheels as shown below. The small rear wheels turn in any direction for steering. The foot rest is adjustable and the front wheels can be locked in position. A nurse evolved the invention.



A wheel chair made from a rocker



Novel Megaphone Amplifies Voices of Singers

E. W. CORNELL, of Adrian, Mich., has designed this strange megaphone for use by singers. The large flare of the funnel is said to furnish amplification of tone without distortion.

The peculiar face piece was devised to produce clear enunciation by permitting normal use of the face and mouth muscles. The appliance is said to be particularly good for church singers and broadcasting.

Says We Can Signal Mars

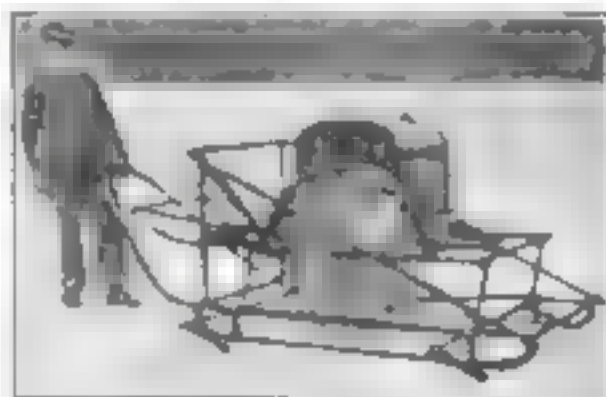
THAT it is entirely possible for the earth to signal Mars by means of signal lights produced at high altitudes by airplanes is the belief expressed by Dr. A. M. Low, an English inventor.

By chemicals, he says, there are ways to produce signals of sufficient size to be readable on Mars, if intelligent beings live there. Wireless, he says, is impracticable. Because wireless waves travel in curves, he observes, it is hard to hit the target.

One-Man Ice Saw Driven by Auto Engine

AN INGENIOUS ice saw driven by an automobile engine cuts nine inches deep at the rate of three feet a second. It is the invention of S. E. Kurtz, of Sac City, Iowa.

The saw is connected directly with the crankshaft of the auto engine, eliminating the transmission. Because of its lightness, automatic spring saw hoist, and automatic gage fingers, one man can operate it.



An auto engine drives the saw

Hope for O. D. Uniforms

THE American Chemical Society is attempting to perfect a domestic dye that will make the faded O. D. uniforms of General Pershing's men look alike in color.

Safety Candle Holders for the Christmas Tree

PERSONS whose homes are not wired for electricity may use lighted candles for Christmas-tree decoration with comparative safety, thanks to a device invented by a Pittsburgh man. This consists of a series of extensible metal arms. Fastened to the trunk of the tree, they hold the candles beyond the branches and decorations.

The arms may be adjusted to any angle, and they are fitted with pins to catch the drip from the candles. The apparatus may be used also for electric lights.



Arms hold candles away from tree



Gas Stove Placed in Tub Heats Bath Water

UTILIZING an odd design of gas stove, a German inventor has devised a quick method of heating water for the bath. After the bathtub has been filled with cold water, the gas stove is placed in the tub until the water is hot enough.

The design of the stove permits a maximum of heat to be transmitted to the water without danger of explosion or extinguishing the flame, for the flame jets are in the upper part of the stove and the lower part is watertight.

Handle of Walking Stick Serves as Flashlight

THE difficulties and hazards of walking over rough roads by night are greatly lessened by this ingenious combination of walking stick and flashlight.



A battery and lamp are set in the handle of the stick, the lamp being attached in such a way that it appears to be only a metal cap for the handle. The pushbutton activating the lamp is located inconspicuously under the handle.

While finding small change, reading house numbers, or looking at one's watch are illustrations of the invention's usefulness.

Aspirin Freshens Flowers

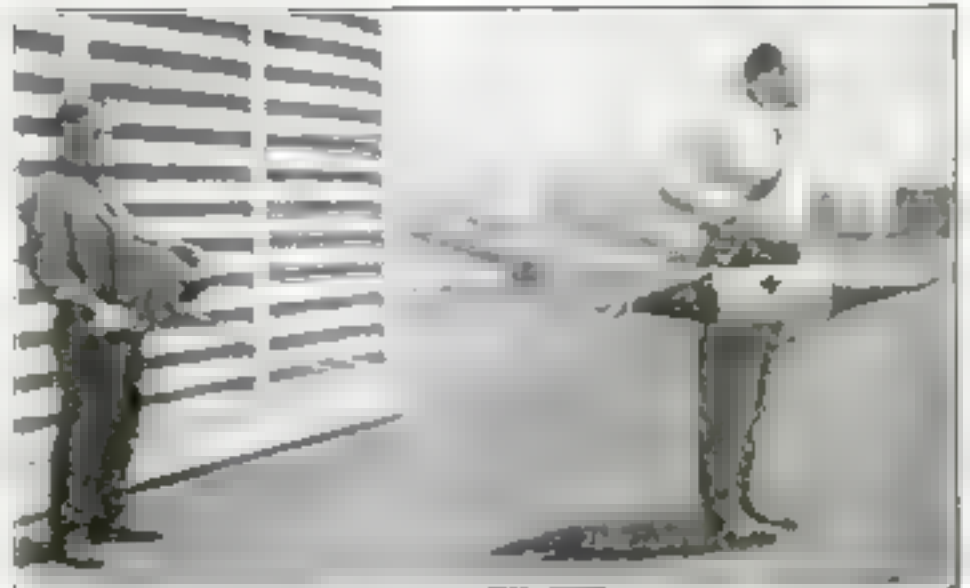
THE best way to revive withering flowers is to dose them with aspirin, according to the announcement of a French scientist. He claims to have discovered that an ordinary aspirin tablet dissolved in warm water will freshen the most delicate cut flowers in vases.

Bathers Rescued by Novel Lifeline

THREE drowning persons were rescued recently from what is said to have been one of the roughest surfs ever recorded on the Pacific coast by a remarkable torpedo-shaped life-saving buoy that enabled the rescuers to carry a life-line to the persons in distress.

The device has a range of 1000 feet from shore and weighs but 25 pounds. Two persons, only one of whom need be a swimmer, operate the apparatus.

A reel containing 1000 feet of sounding wire is suspended from the shoulders of the man on shore. It is attached also to a wide belt about his body so that the strain of pulling in the reel is distributed. Connected with the reel by a sounding wire is a cylinder, with torpedo-like ends to cut the water. The wire connects also



The rescuer swims with the buoy attached to reeled line

with a harness worn by the second man, who swims out with the buoy to the victim. The cylinder has great buoyancy and, it is said, can be carried nearly twice as fast as the standard carry life-buoy.

If the wire becomes entangled in seaweed or wreckage, the rescuer releases a snap swivel that frees him from the wire and swims in, using only the cylinder.

Concrete Granary Filled by Motor

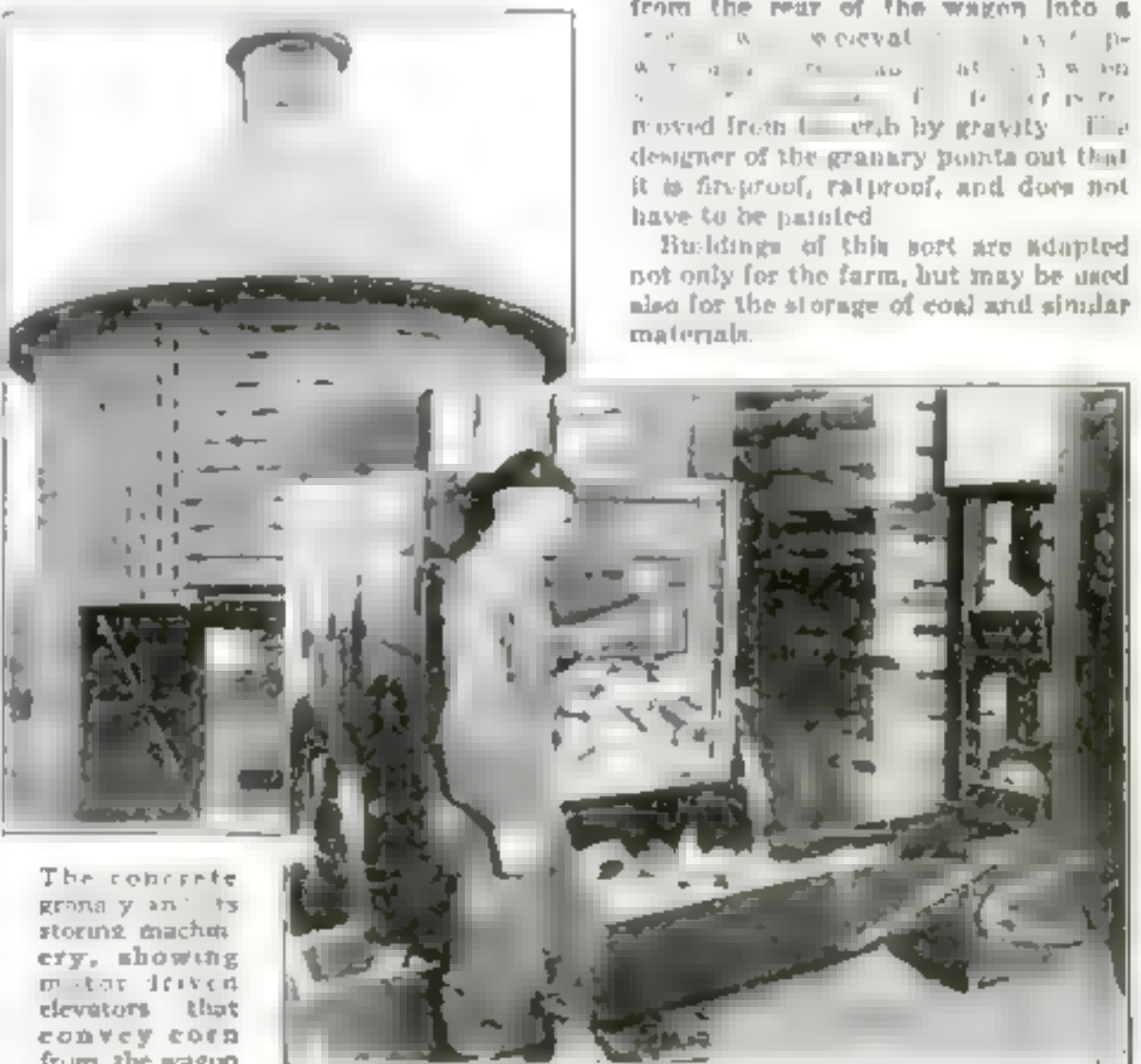
A CONCRETE granary and corncrib, scientifically ventilated and containing a motor-driven elevator that fills it automatically, has been designed and constructed by P. W. Benjamin, on his farm at Bloomington, Ill.

While the building follows the design of the familiar silo, it is constructed of con-

crete slaves. On two sides of the building the slaves are supplied with vent holes that permit the air to circulate through the stored fodder and prevent it from spoiling.

Under the structure is a passageway large enough to admit a horse and wagon or motor truck when the fodder is being stored. The corn or grain is dropped from the rear of the wagon into a hopper, where it is received by a platform scale. The grain is then moved from the crib by gravity. The designer of the granary points out that it is fireproof, ratproof, and does not have to be painted.

Buildings of this sort are adapted not only for the farm, but may be used also for the storage of coal and similar materials.

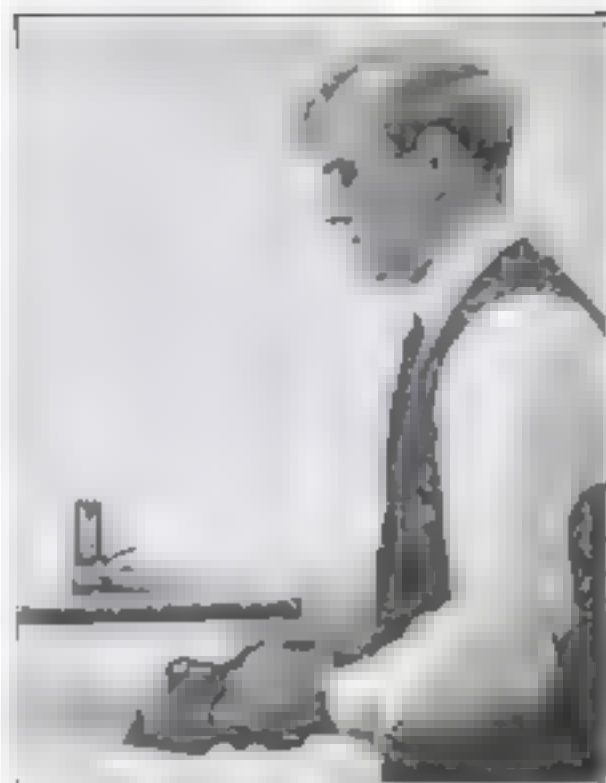


The concrete granary and its storing machinery, showing motor-driven elevators that convey corn from the wagon

World's Biggest Torch-Cutting Job



UNDER the fierce heat of an acetylene torch, the 27-inch solid steel shaft shown here was cut in two in about 15 minutes recently in a railroad yard in Los Angeles, Calif. This is said to be the biggest job of acetylene cutting ever undertaken. Sixteen tubes of oxyhydrogen gas were consumed, maintaining a constant temperature of 3500° F.



Setting hand saw with rotary tool

Protractor and Depth Gage Combined in One

A RECENT contribution to the list of time-saving machine tools by a concern in Athol, Mass., is a combination protractor and depth gage in which the protractor arm serves as the blade of the depth gage. Any desired angles can be laid off or measured and the depth of machined channels can be determined.

When the device is used as a protractor, any angle in one half a circle can be laid off with the blade, and the angle of a piece of work measured. For use as a depth gage the blade can be set at any length within six inches. When thus used, a set-screw is loosened and the blade set to project any distance below the protractor base. Lining up the blade along the 90° mark at the top insures accurate measurement.



Above: Measuring the depth of a slot in a machined casting with the combination protractor and depth gage

At the left: How the protractor arm serves as the blade of the depth gage. For adjustment, the set screw is loosened and the blade set to any desired depth

Hand Saws Set in Minute by New Rotary Tool

A ROTARY saw set recently patented is said to set a hand saw accurately in one minute. Guide bars hold the saw in place and an adjustment at the bottom, by a turn to the left or right, accommodates the particular width of the saw being set.

Different set wheels are required for saws with varying numbers of points to the inch. These are changed easily. Drawing the set once the length of the saw completes the setting.

Barrel-Header Is Driven by Oil Pressure

AN ENTIRELY self-contained barrel-heading press, driven by oil pressure has been devised by a Florida man.

A pump supplying the pressure is mounted directly on the base of the machine and connected by a short nipple with the base casting. In this casting are oil passages and a rotary valve controlling the operation of the plunger. The oil reservoir is cast into the base of the machine. Two operating pedals raise and lower the press.



Oil pump applies pressure to head

Combination Machine Tool Cuts Two Ways



Roughing and finishing with two-way tool

THIS novel machine tool and holder, designed for cutting on both the forward and return strokes, is the recently patented invention of a Chicago shop foreman.

The device is equipped with two cutters, one a roughing tool, and the other a finishing tool. On the forward stroke the finishing tool rides over the work while the roughing tool makes a cut. On the return stroke the operation is reversed.

Finally, when the tool-holder has been fed all the way, the surface of a casting or other work is finished.

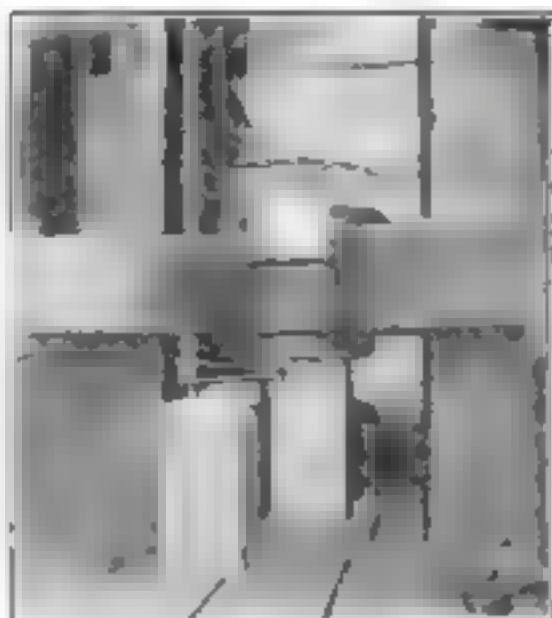
DEVELOPMENT of a new system of making iron castings from "long-life molds" has been announced by a carburetor manufacturing company of Detroit, Mich. The new mold, it is reported, will produce six two-pound castings a minute.

Million-Pound Pressure Proves Strength of Knotty Wood

SCIENTIFIC tests recently completed in the laboratories of the United States Forest Service at Madison, Wis., have exploded the theory held by builders that knots in timber necessarily impair seriously its supporting strength. By means of a huge machine that applies a vertical pressure of 1,000,000 pounds and is capable of receiving timbers 30 feet long and 12 inches square, it was demonstrated that knots have virtually no influence on the stiffness of timbers, and so, little effect on the column strength.

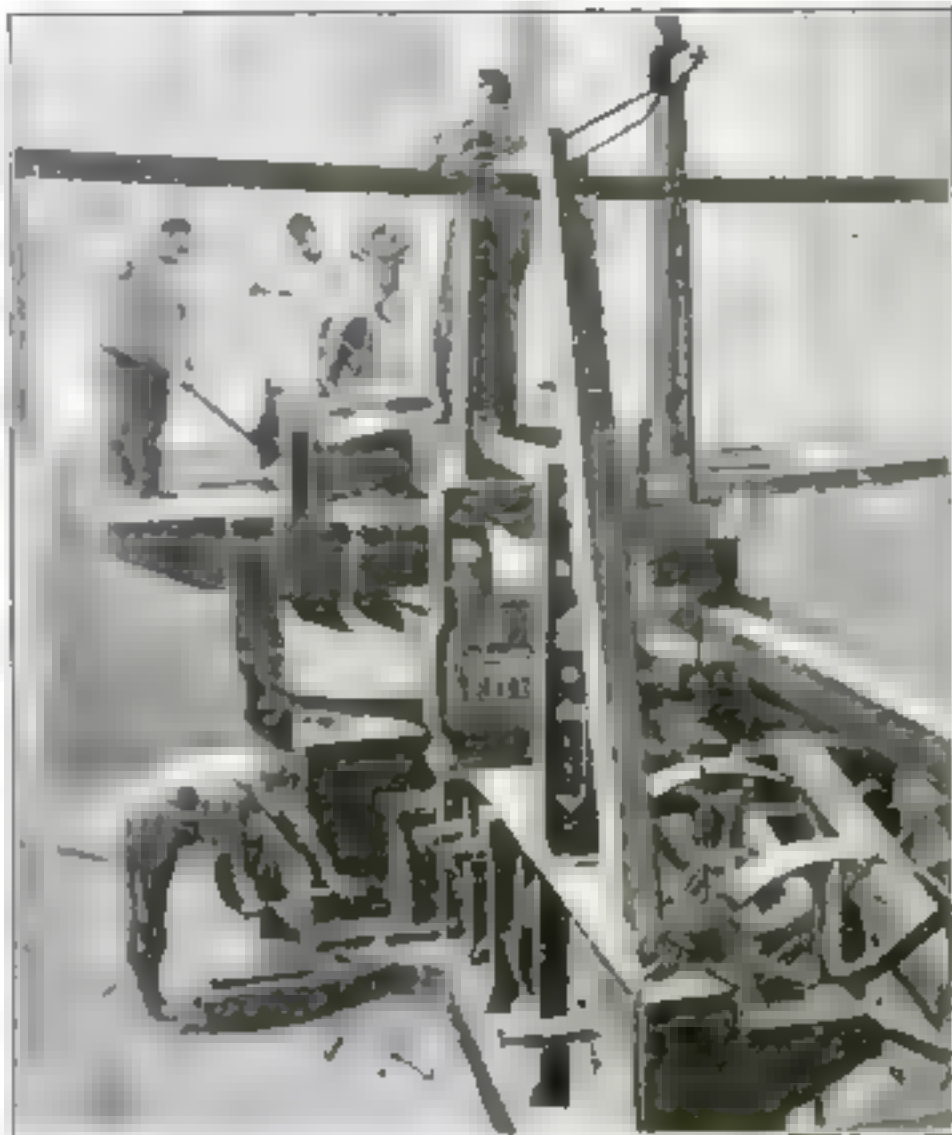
This discovery, the laboratory officials say, is of immense importance, since many thousands of dollars now are wasted annually in building operations by discarding knotted timbers or using timbers larger than is needed to support a load.

The results of the recent tests, however, do not mean that knotted timbers are to be deliberately sought, since knotted timbers come from the upper portions of trees, and have less density and elasticity than wood from the lower trunk. In the tests Southern yellow pine was demonstrated to have a column capacity as high as 432,600 pounds.



A short column of yellow pine under tremendous pressure in the million-pound test machine.

The massive construction of the timber testing machine, capable of exerting a million pounds pressure, is shown at the right. The machine weighs 150,000 pounds.



New Adjustable Drill for Metal or Wood

A NEW adjustable tool for cutting circular holes in sheet metal, wood, or fiber has been perfected by a tool-manufacturing concern in Cincinnati, Ohio. A lead hole is first drilled by a central drill, to which the tool-holding frame is attached. On this frame slide two cutting blades, which can be adjusted to cut holes from one to four inches in diameter and up to seven-eighths inch deep.



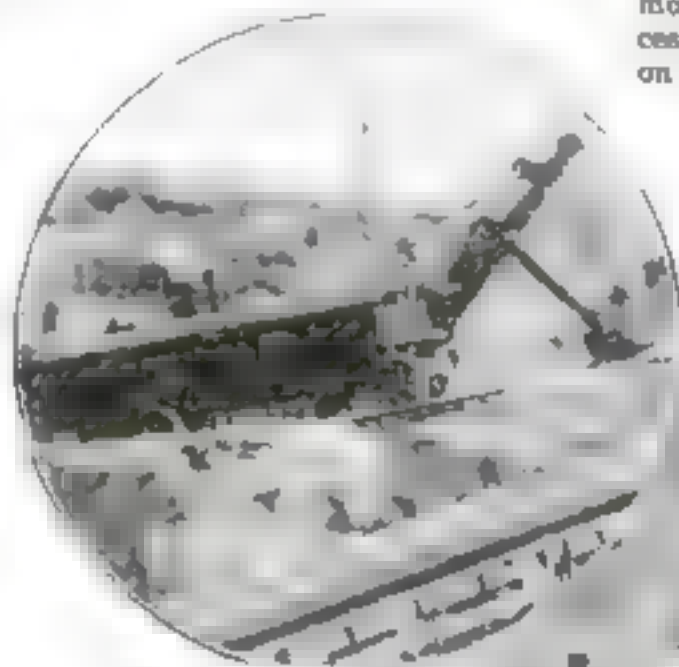
The frame of the tool is of malleable iron, while the two cutting blades are of tool steel, ground and tempered. Adjustment is accomplished by means of two knurled thumbcrews. A scale on the metal body aids in obtaining accurate diameter dimensions.

The tool is especially useful for work on automobile dashboards.

THE editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue of POPULAR SCIENCE MONTHLY.

Huge Steam Shovel Is Hill Climber

STEAM shovels of such size that manufacturers never before attempted to mount them on anything but standard railroad trucks recently have been successfully equipped with traction wheels, giving them extreme mobility and the ability to ascend and descend steep slopes easily. The shovels are hauled by the forward wheels, driven by powerful shovel engines, and steered by rear wheels.



Above: A steam shovel mounted on traction wheels climbing the steep side of an 80-foot pit in a stone quarry at Elmhurst, Ill. At the right: The same shovel at work in the quarry.

In a quarry near Chicago a shovel 85 feet long, with traction-wheel equipment recently descended into and climbed out of a pit 80 feet deep. Such a feat would have been all but impossible for the same machine on tracks. At a Pennsylvania quarry a huge traction wheel shovel was moved in one day a distance that under the old track-laying methods would have occupied at least 10 days. A shovel mounted on traction wheels also was successful in replacing a derailed dump train on the tracks in a few hours in a Michigan quarry.

Engineers say traction wheels for the mounting of large shovels possess many advantages over railroad trucks, including greater mobility, easier accessibility to the face of an excavation, elimination of tracks and consequent lowering of expense.



Relief Springs Smooth Rough Roads

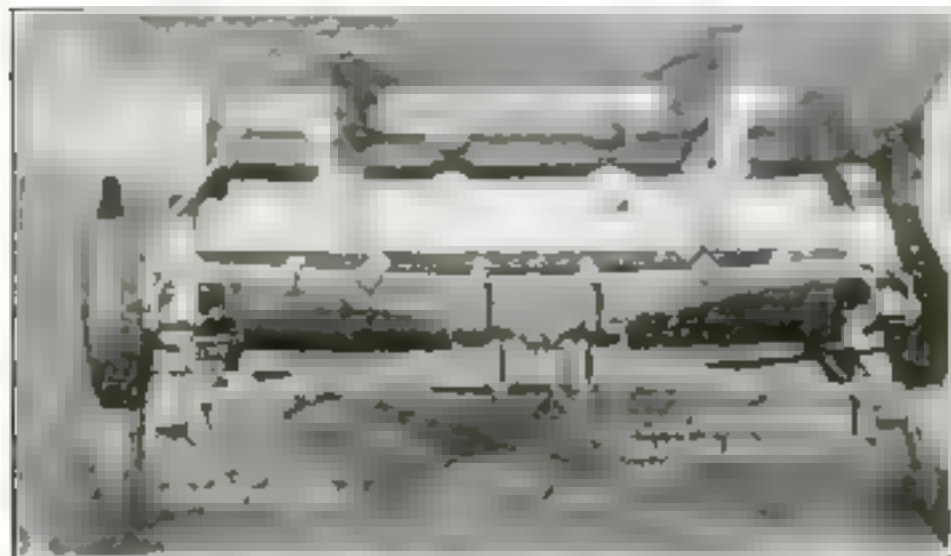
AUXILIARY springs of a distinctly new type that are claimed to give Pullman-car ease on the meanest road, may be attached to most makes of automobile at small cost.

The rear auxiliary relief spring is composed of double transverse, straight

laminated springs. These are secured together at their centers, with a roller-bearing oscillating joint between. Each end of the upper spring is connected with the side frame by a roller-bearing device, and each end of the lower spring is held in contact with the main side springs by a

rubber-padded stirrup with a ball bearing between the springs. This gives a frictionless connection and allows a great range of spring or axle movement. It provides also a three-point suspension for the rear of the frame.

It is said that this arrangement reduces the effect of end thrust movement and sideways and will damp out sharp rebounds.



The rear auxiliary relief, showing double transverse springs with roller bearing joint, and roller bearing body support

Views Scenery in Auto Telescope

MOTORISTS who may wish a closer view of attractive bits of landscape, or who have a leaning toward amateur astronomical investigation, will be interested in the homemade automobile telescope that a Vermont man has attached to the windshield of his car. The instrument is mounted on a ball-and-socket bracket, permitting it to be set in any position to observe earth or sky. An eyepiece with a half-inch focal length enables observations to be taken without getting into uncomfortable positions and also magnifies the images in the telescope 40 times.

The telescope has a 3 1/2-inch mirror with a focal length of 20 inches.

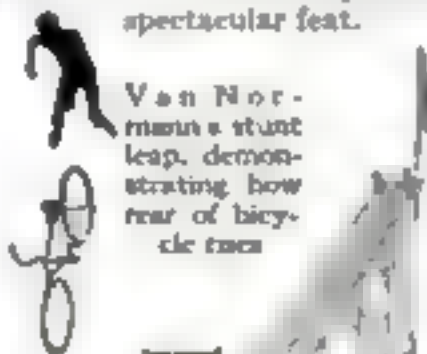


Daredevil Says Front Seat Is Safer

A NOVEL theory as to the relative safety of the front and rear seats of an automobile is offered by J. H. Van Normann, a circus daredevil of Bridgeport, Conn. He asserts that the rear of the car is more dangerous to ride in than the front, and claims he proves it by the way in which he performs the thrilling stunt shown here.

According to Van Normann, centrifugal force will hurl out the occupants of the rear seats in an accident, just as he is hurled 50 feet into a net by this agency when his bicycle finishes its descent of a long in-

cline and shoots off into space. The photograph shows how the front of the bicycle falls and the rear rises as he performs the spectacular feat.



Checking on Trucks

TO KEEP track of the movements of motor trucks or delivery wagons, a Cleveland manufacturer has devised the ingenious dial recorder shown here. It may be attached to the dashboard, beneath the seat or to any other convenient part of the body.

A dial of paper surfaced with wax, on which are marked the 24 hours of the day, divided into 10-minute intervals, is contained within the case and attached to clockwork that causes it to make a complete revolution once in 24 hours.

The case also contains a pendulum that swings from side to side with the sway of the car. To this pendulum is attached a sapphire-pointed stylus that scratches the waxed paper as it moves.

Moving along the edge of the dial, this stylus records when the car was moving or at rest.



Auto Engine Cooks Meals while You Ride

AN OVEN attachment for automobiles has been perfected by James E. Z. Fowle, of Preuss, Ore. The oven has a compact rectangular casing, shaped so that it will seat snugly over the exhaust manifold of the engine.

The top carries two rods terminating in hooks that engage over the radiator stay rod, thus holding the oven securely. Coffee, stews, and boiled eggs may be prepared while the car is in motion. Hot cakes or fried eggs can be cooked on a hot plate at the bottom of the oven.

How to Enjoy Your Car in Winter

By George A. Luera, M.E.

Noted Auto and Mechanical Engineer

AS I was walking down the steps of my home one morning early last December I saw a neighbor standing at the curb. He was gazing with pained expression at his automobile, a smart car of a well known make, bought only a few months before. As he heard me approach he looked up and pointed silently toward the front of the car.

Water was pouring from the bottom of the radiator in a flood.

Radiator Was Only Half Drained

"Frozen, eh?" I observed, for the night before had brought the first really cold weather of the year.

"No," he denied. "It can't be frozen. I haven't used the car in a week, and I drained the radiator the last time I put the car away. I noticed it was leaking when I started to back out just now. I can't understand it."

I stepped to the front of the machine to examine it. The core—the honey-comb-like center—of the radiator was split where it joined the lower tank and along the fissure was a strip of ice. I puzzled for a full minute before I found a possible explanation, and, when I questioned the car owner, my guess proved to be correct.

Instead of actually draining his radiator in the only way in which it can be done thoroughly—by removing the plug at the bottom of the lower tank—my neighbor had attempted to draw off the water by turning the cock beneath the water pump. This had permitted the water to flow from the upper part of the radiator, but because the cock is on a level with the lower tank, this tank had been left full. The water had frozen when the temperature fell the night before. As a result a new radiator core was necessary before the car could be used again and this meant a heavy repair bill.

Freezing Water Is Common Trouble

My neighbor's experience is a typical instance of the sort of trouble into which ignorance, inexperience, and carelessness often bring motorists during cold weather. Operating an automobile during the winter is a different thing entirely from driving the same car in milder seasons. The automobile has been improved in a thousand ways since the days when every owner put his car up for the winter, but not yet can it accomplish the transition from relatively warm weather to cold unless it is prepared for the change.

Everybody knows that water freezes, yet the most frequent cause of trouble and expense to the winter driver remains the freezing of the water in the cooling systems of cars. The man who lets this happen deserves little sympathy. You know when cold weather may be expected, and you should prepare your car for it in advance.

Before the first cold weather comes drain your radiator at night. Better



Operating an automobile in winter is a different thing entirely from driving the same car in summer. An automobile is like a human being. To weather the transition from warm sunshine to the snow and ice and freezing temperatures of winter it must be prepared for the change.

still, fill it with an alcohol or other non-freezing solution. It is better to pay for a few pints of alcohol which you really do not need than to be forced to pay a bill

for a split radiator, broken pump, or cracked water jacket.

There are many anti-freezing compounds that you may use, but denatured alcohol is as efficient as any and is probably the most easily obtained. A proportion of one-fifth alcohol to four-fifths water will prevent freezing at temperatures above 15 degrees, while a mixture of half alcohol and half water will not freeze above 34 degrees below zero.

Since anti-freeze solution is somewhat expensive, it is well to prevent loss by leakage by inspecting the hose connections, gasket and pump packing and renewing any of these which may need it.

As a further precaution a leather radiator cover is valuable for retaining heat when the engine is idle.

Some Ordinary Winter Precautions

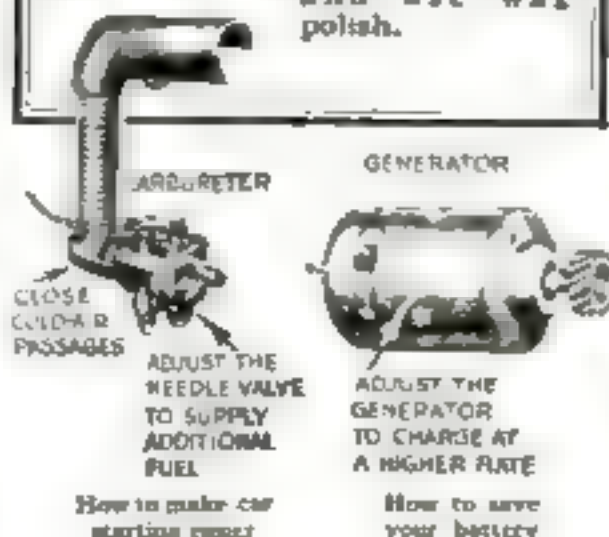
Cold weather also affects lubricating oils will congeal in the winter, making the engine and transmission stiff. This requires much additional power from your battery in starting, and tends, of course, to discharge it. Light grades of engine and gear oil should be used in winter unless, of course, the manufacturer of your car expressly advises against this. The lighter oils will remain more fluid than heavy oils in cold weather and consequently will reach bearings and gears more readily.

Tire trouble, too, is frequent in winter. Chips of ice cut the casings, water from melting snow seeps into the cuts, freezes and rapidly destroys the rubber and carcass. You will do well, then, to start the winter with a set of new tires, to make frequent inspections and to repair cuts as they develop. A set of good tire

Preparing Your Car

HERE are important pointers to observe in preparing the body of your car and its accessories to weather the snow and ice and bitter cold of winter.

TOP	Repair breaks and untacked seams.
CURTAINS	Replace broken or discolored glass.
WIND-SHIELD	Fasten bolts, oil hinges and provide a wiper.
DOORS	Adjust lost-motion devices, oil latches and hinges.
BODY	Tighten frame bolts and dash bolts.
FENDERS	Tighten nuts on brackets and braces.
PAINT	Enamel bare spots and use wax polish.



chains for use on icy, snow-covered or slippery highways is, of course, an essential.

In addition to caring for such details as these, a thorough inspection of the car to detect and correct possible mechanical defects should precede its winter use.

In the winter you need all the power your motor can develop. Be sure there is no loss of power through leaky compression or worn valves. If the motor turns over easily on compression strokes, it is a sign of leaky compression which should be corrected by a new set of piston rings. Then inspect the valves and guides. If they are worn, they should be replaced.

When the Lubricant Congeals

Congeaed lubricant in your transmission case will make the action of your transmission sluggish. To compensate for this, adjust the sliding gears for free movement and increase the tension of the clutch springs.

When the highways are covered with snow or ice, your brakes are under an exceptionally heavy strain. For safety in winter driving, be certain that your brake linings are not worn. If they are, have the brakes relined before you risk driving your car. The brakes should be adjusted loosely for winter driving, so that grit, thrown against them from wet roads, will not wear the linings out too fast.

Sharp turns are dangerous in winter, because of slippery traction. For this reason your steering gear should be adjusted so that the lost motion in the steering wheel will be slight—not more than an inch. The steering gear should not be made so tight, however, that the wheels cannot be swung instantly to counteract the least tendency to skid.

Driving in and out of frozen wheel tracks and over banks of snow subject wheel bearings to heavy strain. Examine the bearings before using your car for the winter and replace bearings that are worn too badly to be adjusted.

The engine and cooling system lose

their heat rapidly in cold air. This loss of heat must be compensated for by adjusting your carburetor for hotter mixture. The needle valve or nozzle should be opened wider to supply the extra fuel needed.

Leakage in the air inlet of the carburetor and failure of the "choke" to close the air inlet properly will give you

On the market are many appliances designed to aid you in starting your car in cold weather—primers, electrical heaters for the carburetor and similar apparatus. One of my acquaintances even carries a thermos bottle filled with hot water, which he pours over the carburetor when he is ready to start his car. Most of these devices really do make starting easier, but, if you have made your car right mechanically before the winter season, you probably will not need them. Flooding the carburetor is an easy way of starting some makes of cars, but is wasteful of gasoline and tends to form carbon.

You can make starting easier for yourself by preparing for it when you stop your motor. Pull your choker rod out and open your throttle the instant you shut off the ignition. This places a heavy charge of fuel in the engine. Since the first movement of the motor adds to this charge when you press your starter pedal, the chances are that the car will start on the first turn.

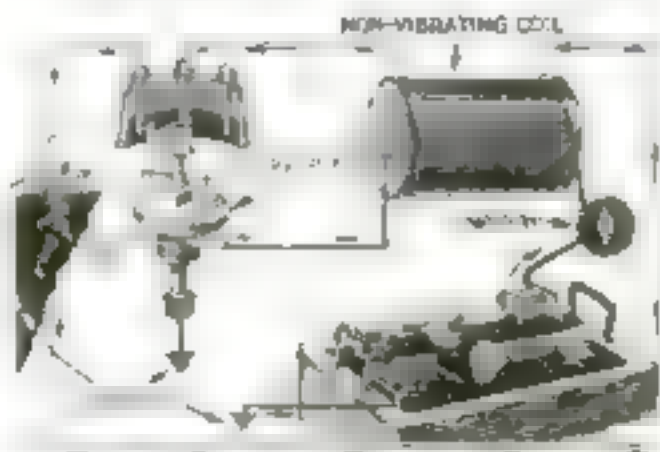
Special Care Is Needed

Driving and traffic conditions vary so much in different sections of the country that it would be useless for me to attempt to suggest rules of conduct to be observed on the roads during the winter. Especial care is necessary, especially when snow or ice is on the highways, reducing friction between the tires and the road. Your car cannot climb the steep grades that it ascended easily when the roads were dry; there is a tendency to skid when descending hills or making turns.

Watchfulness is necessary both on the roads and in the garage during the winter; but if you will exercise intelligent care, you can drive your car with just as much safety and enjoyment as in summer.

ARE you planning to buy a new car this year? In making your selection don't fail to look over the new improvements in 1924 designs which will be described in next month's issue.

KNOW YOUR CAR



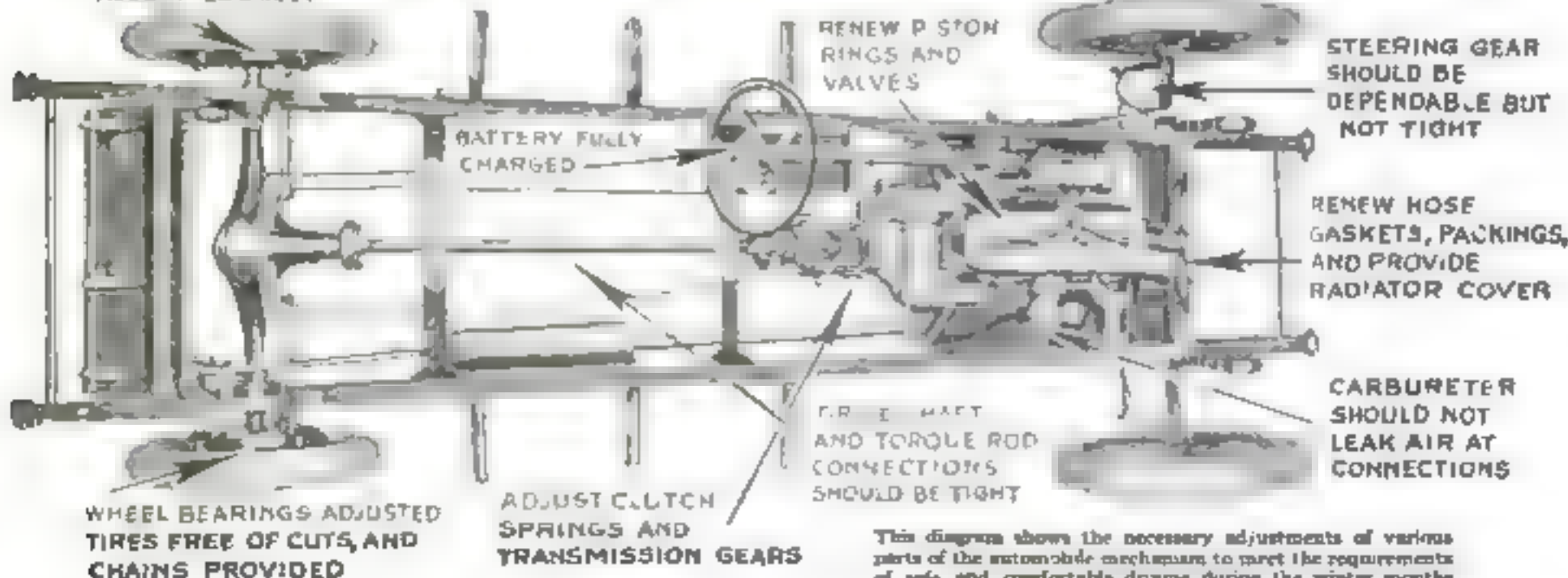
Your Spark Plugs—The sparks that jump across the gap between the points, or terminals, of the spark plug are produced by a high-tension induced current in the manner shown in this diagram of a typical ignition system. Low-voltage current from the battery is led through the ignition switch to an induction coil, which "steps up" the electric voltage from 12 to more than 5000.

The battery current passes from battery to coil, then to interrupter through ground and back to the battery. The high-tension current, induced by the coil, passes through the timer across spark gap, through ground and back to the coil.

trouble in starting your car when the engine is cold. Replace any worn or leaking parts in the air inlet and adjust the choke to close fully.

The difficulty of starting even mechanically perfect cars in winter tends to wear out the battery quickly. The generator can be adjusted to charge the battery at a higher rate. The average motorist probably will do well to have this adjustment made at a good service station. It is probably safe to say that a generator adjustment that will charge the battery at the rate of 20 amperes when driving at 30 miles an hour will be about right for the average car.

RELINER BRAKES AND
ADJUST LOOSELY



RENEW PISTON
RINGS AND
VALVES

STEERING GEAR
SHOULD BE
DEPENDABLE BUT
NOT TIGHT

RENEW HOSE
GASKETS, PACKINGS,
AND PROVIDE
RADIATOR COVER

CARBURETOR
SHOULD NOT
LEAK AIR AT
CONNECTIONS

DRIVE SHAFT
AND TORQUE ROD
CONNECTIONS
SHOULD BE TIGHT

ADJUST CLUTCH
SPRINGS AND
TRANSMISSION GEARS

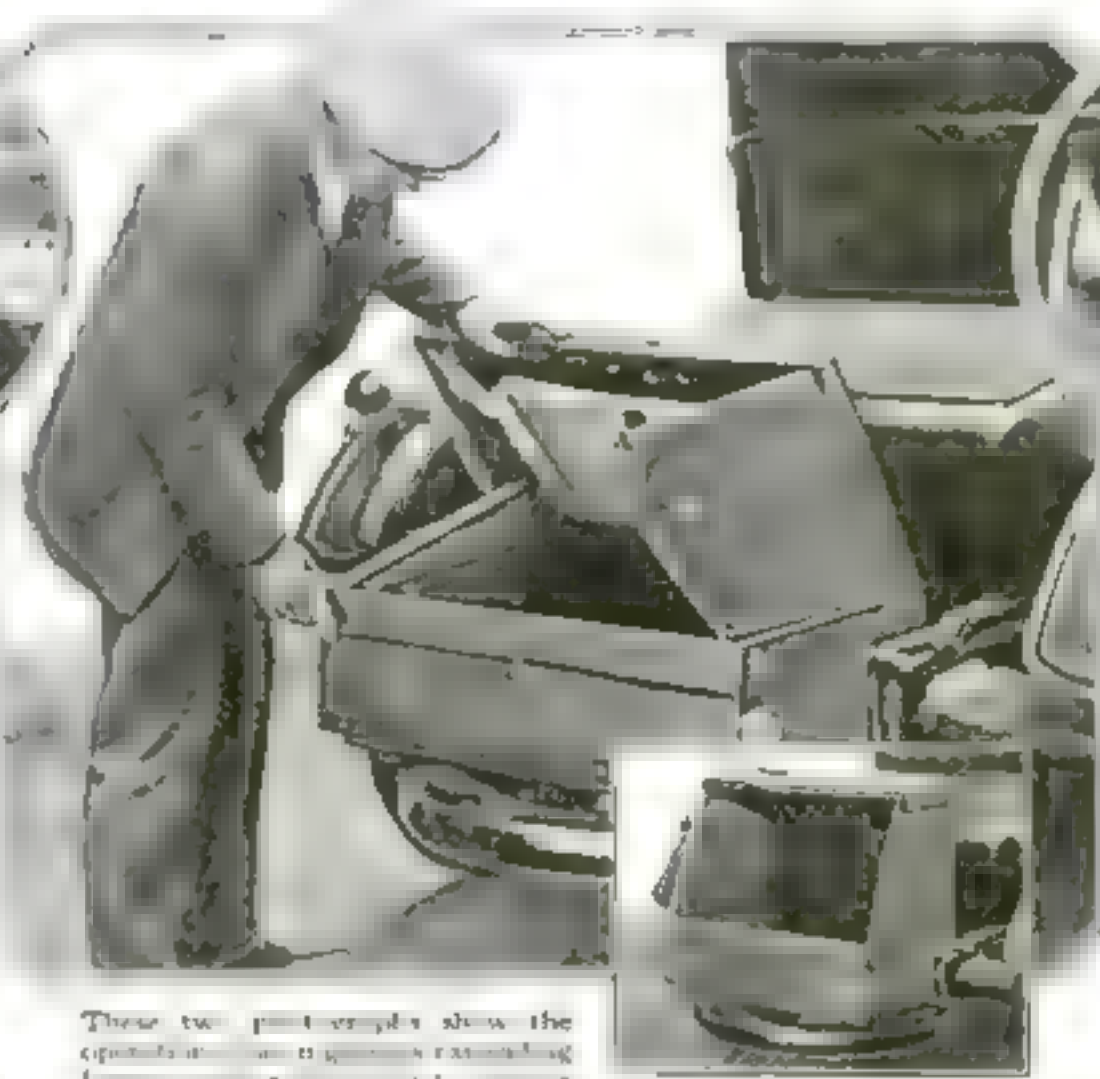
WHEEL BEARINGS ADJUSTED
TIRES FREE OF CUTS, AND
CHAINS PROVIDED

This diagram shows the necessary adjustments of various parts of the automobile mechanism to meet the requirements of safe and comfortable driving during the winter months.

The Newest Aids to Better Motoring



Danger of accident in entering a curve is minimized by this device which automatically adjusts the steering to the curve of the road and ground.



Variable performance motor of constant speed is controlled by a control knob. As the knob is pushed, the motor speed is increased or decreased.



Heavy duty motor is used in the car for the purpose of increasing the speed of the motor. The motor is built of angle iron.



These two pictures show the operation of the motor. The motor is built of angle iron and is used in the car for the purpose of increasing the speed of the motor.



These safety light signals are controlled by a two-way switch on the dashboard. Upper picture shows the signal when the car is in motion. Lower picture shows the signal when the car is stopped.



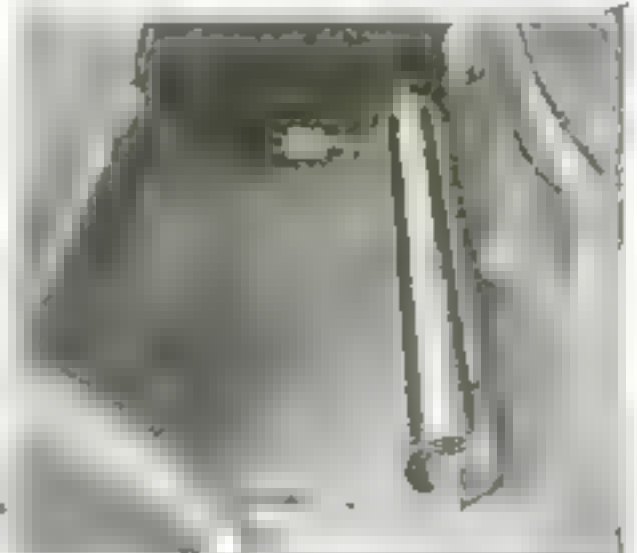
This tire chain is said to be unusually effective in preventing skidding, and to be very easy on the tires.



In this friction shock absorber steel blades attached to the axle move between leaves of specially treated friction material attached to frame.



This extension in the gas lever of a Ford car moves a pushbutton that makes it possible to dim the lights of the car without removing your hand from the wheel. The extension also facilitates control of the gas lever.



A tubelike footrest serves as a convenient container for the tire chains. The container also may be used as a gasoline or water container.

Labor-Saving Kinks for the Autoist

BY THE relatively simple modification illustrated in Fig. 1, an auto steering wheel of the usual fixed type can be converted into a hinged or tilting wheel. This applies, however, only to a car on which the spark and gas quadrants are not mounted on the wheel. It is particularly useful in converting an old car into a sport model. The wheel spindle is cut off and slotted to form a hinge joint and an extension fastened on, as shown. This extension is threaded for a large wingnut. A key prevents the wheel from slipping.

TWO nails and a block of wood are used to make the simple tester for spark plugs shown at Fig. 2. A hole is bored near the end of the block, as indicated, and the nails are driven in at an angle so that the points will be about $\frac{1}{8}$ in. apart. In use, one nail is touched against the terminal nut on the spark plug, while the other is placed against the metal base of the plug. —F. M. P.



Fig. 2. Spark tester

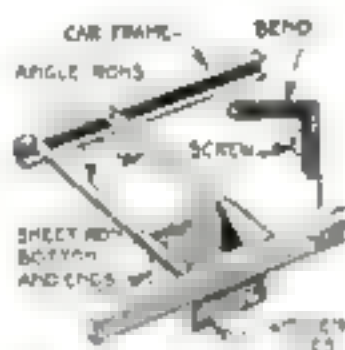


Fig. 3. Battery box



Fig. 7. Cheaply made radiator filler

BY PURCHASING a 50-gal. drum of gasoline, the car owner can save from 2 to 5 cents a gallon. The main objection to buying gasoline this way is the difficulty of handling the drum. This can be overcome by providing two brackets, as shown in Fig. 8, to support the drum at a level corresponding to that of the delivery truck. Two rollers are set in each bracket in such a way that the drum can be rotated without difficulty.

A large filling bung is drilled, tapped, and fitted with the usual metal spigot, and, once made, this special cap is kept for each new barrel of fuel. To pour the gasoline, the drum is turned over until the spigot is in a convenient position, and afterward is rolled back with the spigot at the top, so that there will be no leakage.

Lubricating oil drums can be handled in the same way. —A. C. T.

THE homemade creeper illustrated in Fig. 4 is unusually comfortable because the upper two fifths of its bed is hinged so that it can be raised when neces-

sary to support the workman's head and shoulders. The materials used in construction are short lengths of narrow pine flooring, a pair of 4-in. strap hinges, four ball-bearing casters, and a 5/16-in. nail rod about 40 in. long. —R. A. FRANKLIN.

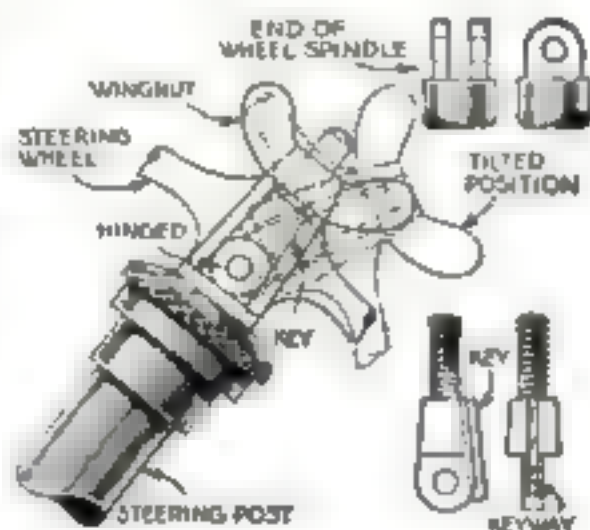


Fig. 1. Tilting steering wheel



Fig. 4. An adjustable rest for the head and shoulders makes this garage creeper unusually comfortable for work under car



Fig. 9. Spring spreader

IN REMODELING an old style auto it is sometimes a puzzle to know where to carry the storage battery. One way is to fasten one of the many commercial battery boxes to the runningboard. Another is to place the battery under the back seat, if space allows. Perhaps the best idea is to arrange suitable brackets under the floorboards.

To fit the angle-iron supports properly to the car frame, the work should be done, if possible, at a time when the body of the car has been removed. Once the iron

cross pieces are in place, as shown in Fig. 5, they cannot work loose. Note that they are bolted or riveted to the top flange of the frame. This is so that the drive-shaft tube will clear them better, but if there seems no danger of the tube's striking the irons, perhaps they can be bolted to the lower frame flange, which makes it unnecessary to remove the body.

AN IMPROVEMENT upon the hammer or punch method of cutting bolt holes in gaskets is to use a tool made by welding a 3/8-in. ball bearing to a length of 1/4 or 3/8-in. rod (Fig. 6). When the gasket has been put in place, the ball is laid on each hole in succession and struck sharply.

One blow cuts a clean hole. —B. S. H.



Fig. 2. Drum brackets



Fig. 6. Gasket punch

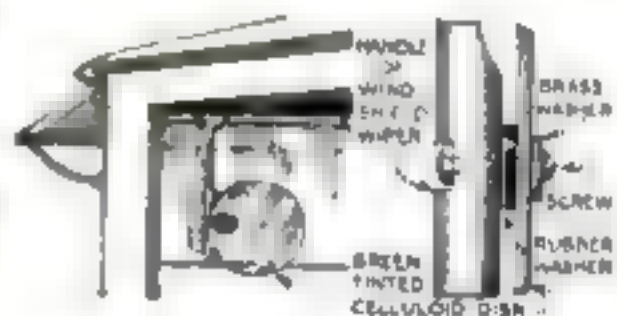


Fig. 8. Glare deflector

of the bucket and holds the hose up when the pail is being filled or carried. —J. L.

ONE motorist uses a simple glare deflector made as shown in Fig. 8. The deflector is a green celluloid disk fastened with a small screw and washers on the inside arm of the windshield wiper. Since the wiper is arranged to move across the windshield, and the glare disk can be swung around in a circle, it is possible to place the deflector quickly in any position desired. —J. N. T.

IN ANY garage where Ford cars are overhauled, the spring spreader shown in Fig. 9 will be found to save much time when removing or placing the spring shackle bolts. Two bars, one with a U-bend, are connected with a turnbuckle and the ends are pointed to fit back of the spring eyes. —L. B. C.



The Home Workshop

Arthur Wakeling, Editor

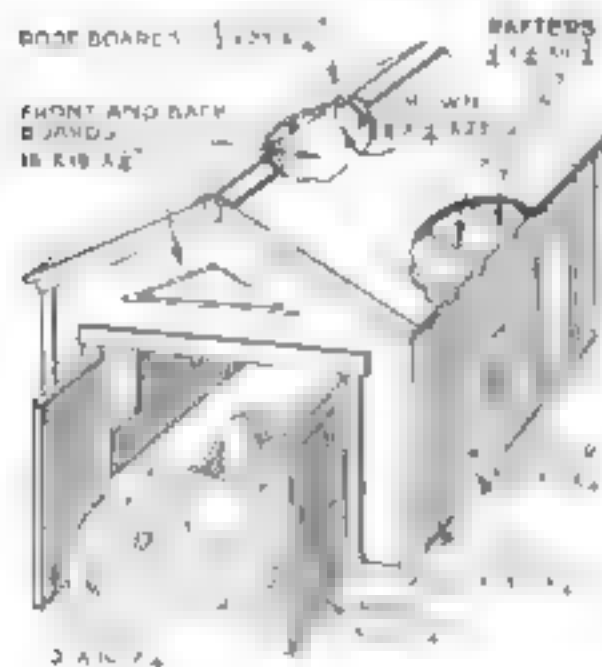
Making Toys to Delight the Kiddies

MAKING toys for the kiddies' Christmas is the most enjoyable work that comes into the home workshop. Every man who is in the least handy with tools likes to build playthings. It is fun to put them together; they always seem to turn out successfully; and they are immensely appreciated by the children.

This is especially true when the toys are so interesting, sturdy, and easily constructed as those illustrated—a toy tea cart and game table, a miniature garage, and a bunny wheelbarrow. These were designed especially for *POPULAR SCIENCE MONTHLY*, and the working details, prepared by George F. Knercher, are given in full in Home Workshop Blueprint No. 29.

Although essentially a girl's toy, the tea cart can be used by the entire family as a portable game table. On the tray—either on the face or on the back, as preferred—is painted a checkerboard. The table can be used also for many other games, and its chief advantage is that it can be wheeled about from room to room or carried up and down stairs.

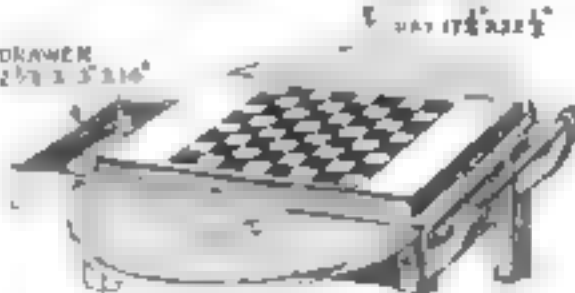
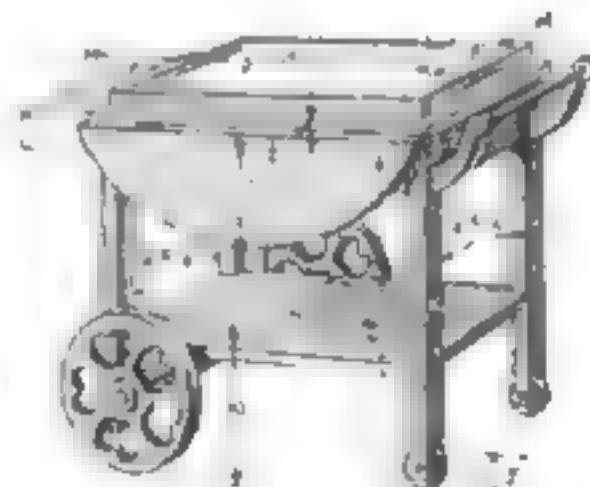
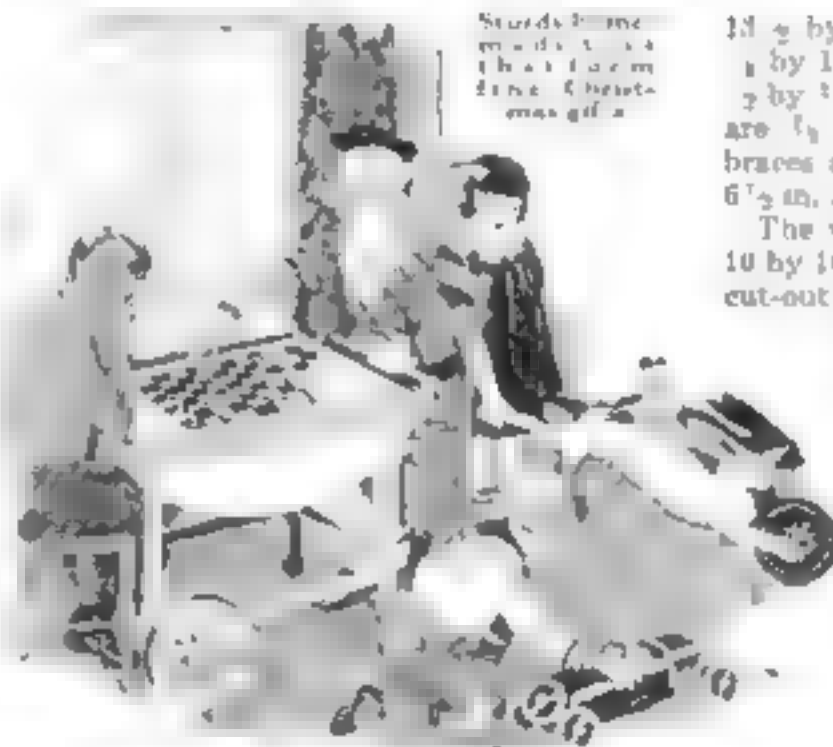
The tea wagon can be made of white-wood, pine, cypress, or any other wood that is easily worked. It is 18 in. wide,



This large toy garage is built of wooden strips covered with wallboard.

2 ft. long, and stands 2 ft. high. The table top is $\frac{3}{4}$ by 18 by 24 in.; and the drop leaves are cut from pieces $\frac{3}{4}$ by 7 by 24 in. The back posts are $1\frac{1}{2}$ by $21\frac{1}{2}$ in., and the front posts are the same stock, but only 17 in. long.

The main top rests on a mitered frame



Although a girl's toy, this tea cart can be used by the whole family for games.

made of two pieces $\frac{3}{4}$ by $2\frac{1}{2}$ by $22\frac{1}{2}$ in., and two pieces $\frac{3}{4}$ by $2\frac{1}{4}$ by $16\frac{1}{2}$ in. The lower shelf is $\frac{3}{4}$ by $15\frac{1}{2}$ by $21\frac{1}{2}$ in., but it is just as well to use $1\frac{1}{2}$ -in. stock, if it is at hand. The heavy shelf reinforces the construction, and it is essential in building toys always to make the parts as strong as possible.

The top side rails are $\frac{3}{4}$ by $3\frac{1}{4}$ by $20\frac{1}{2}$ in., and one end rail is $\frac{3}{4}$ by $2\frac{1}{2}$ by 13 in. The drawer front is the same size as the end rail. The sides of the drawer are $\frac{3}{4}$ by $2\frac{1}{2}$ by 14 in., the back $\frac{3}{4}$ by $1\frac{1}{4}$ by $12\frac{1}{2}$ in., and the bottom $\frac{3}{4}$ by

$13\frac{1}{2}$ by $12\frac{1}{2}$ in. The two runners are $\frac{1}{2}$ by 1 by $19\frac{1}{2}$ in., and the two guides, $\frac{1}{2}$ by $\frac{1}{4}$ by 14 in. The two drawer rails are $\frac{1}{4}$ by 2 by 13 in. The table leaf braces are cut from pieces $\frac{3}{4}$ by $4\frac{1}{2}$ by $6\frac{1}{2}$ in., and are hinged to the side rails.

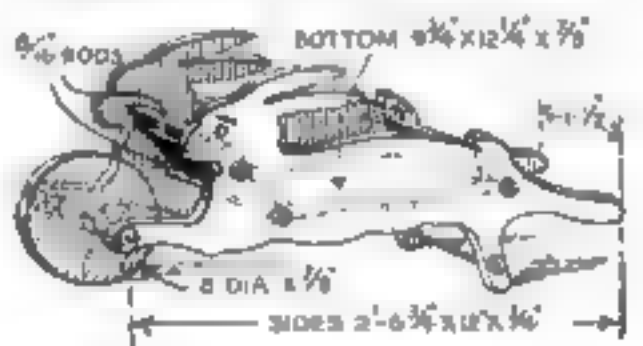
The wheels are cut from pieces $\frac{1}{2}$ by 10 by 10 in. They can be lightened by a cut-out design, as shown, or they can be left solid. Baby carriage or toy express wagon wheels, or any other kind of small wheels can be used, if at hand. The front axle is $1\frac{1}{2}$ by $1\frac{1}{2}$ by 19 in. The small back wheels are cut from pieces $\frac{3}{4}$ by $2\frac{1}{2}$ by $2\frac{1}{2}$ in., and turn on wooden pins $1\frac{1}{4}$ in. long and $\frac{1}{8}$ in. in diameter.

The two handle brackets are cut from one piece $\frac{1}{2}$ by 8 by 9 in. A $\frac{3}{8}$ -in. dowel $15\frac{1}{2}$ in. long is used for the handle bar.

The tray bottom is $\frac{3}{4}$ by $16\frac{1}{2}$ by $21\frac{1}{2}$ in., with sides $\frac{1}{2}$ by $1\frac{1}{2}$ in., mitered round.

Two washers for the front wheels, one drawer knob, two drawer stops $\frac{1}{2}$ by $\frac{1}{4}$ by 1 in., two tray handles 9 16 by $\frac{3}{8}$ by $3\frac{1}{2}$ in., rubber or felt tray feet, screws, nails, and brads are also needed.

Mortise and tenon and doweled construction is preferable because of its strength, but the parts can be nailed or screwed together with much less work. Small angle irons, mending plates and box corners can be used to advantage in strengthening toy furniture of this type.



The bunny wheelbarrow makes a certain hit with the younger children.

when the joints are merely nailed or screwed together.

The simplest method of finishing the tea wagon is to give it one or two coats of enamel undercoating, or flat white paint, and one or more coats of enamel. It is advisable to use only the best materials in (Turn to page 107)

How to Make a Radio Set for Christmas

By Joseph Calcaterra
Of POPULAR SCIENCE MONTHLY'S
Radio Staff

NOTHING could be more in keeping with the Christmas spirit this year than the presentation to the household of a good, reliable radio set. The joy that such a gift will bring to every one in the family is certain to be lasting. The radio set offers a solution to the question, "How can we make evenings at home enjoyable enough to compete with the club and the movies?"

For ease of construction, simplicity of operation, and general all-around efficiency the double-rotor type of tuning unit has few rivals. Why it has not enjoyed greater popularity is hard to understand. A tuner of this type is the heart of the two-stage receiving set illustrated. A rear view of the unit is shown in the photograph of the back of the set, the front view is illustrated in connection with Jack Binns' article on page 59.

Two rotors, one at each end of the stator tube, are used. The secondary coil of the circuit is wound on one rotor while the tickler coil, used to provide regeneration, is wound on the other rotor.

Taking into consideration the selective features of double circuit tuning, combined with the great signal strength obtained by regeneration, the receiver described this month is one of the most compact and efficient it is possible to construct.

The circuit provides for three coils, a primary, a secondary, and a tickler coil, placed in inductive relation with each other. The primary coil consists of 63 turns tapped at every seven turns, with a 23-plate condenser placed across the coil to provide closer tuning. The coil is made of No. 20 s.c.c. wire wound on a tube 4 in. in diameter and 4 1/2 in. long.

A Condenser Tunes the Secondary

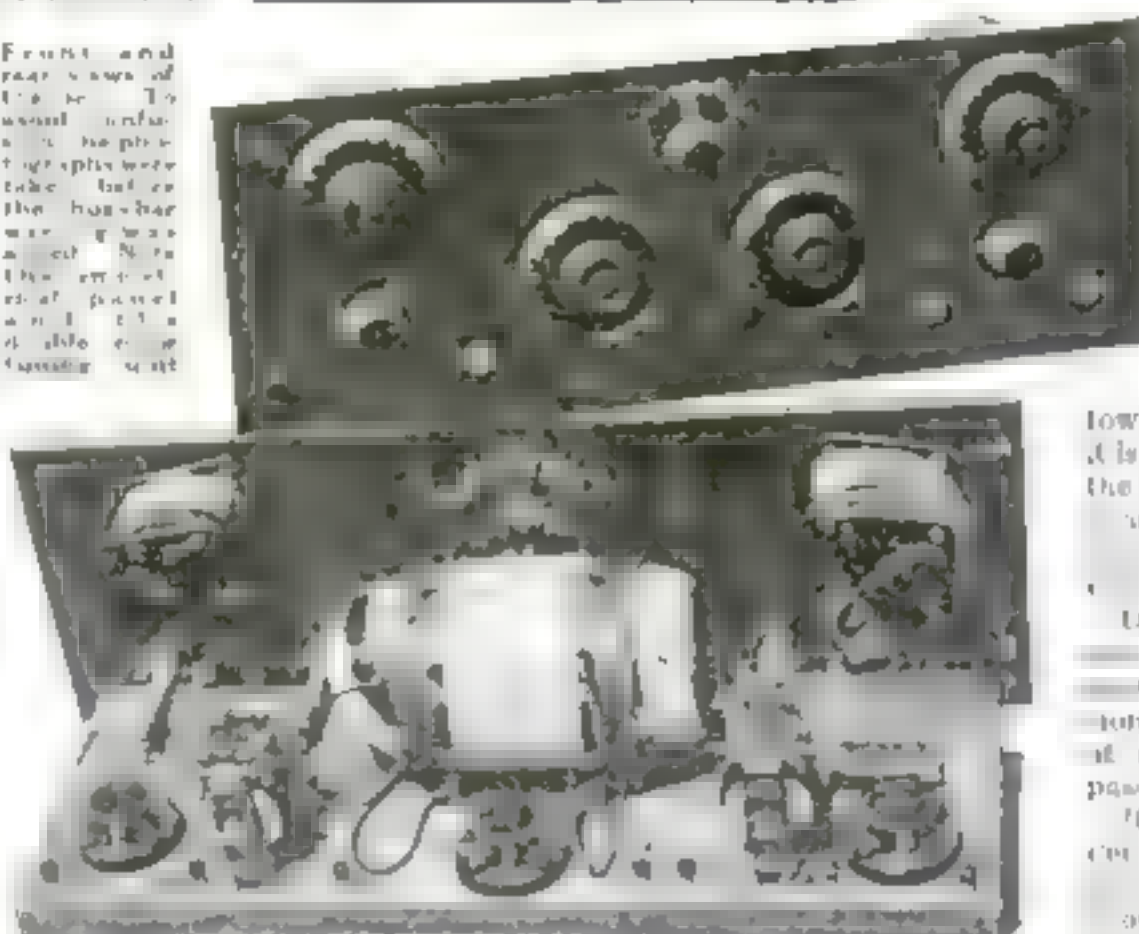
The secondary and tickler coils are fixed inductances consisting of 50 turns of No. 24 s.c.c. wire wound on 3 1/4 in. rotors. A 23-plate condenser, placed across the secondary coil, is used to tune the secondary circuit.

It is not necessary to adhere strictly to the dimensions given if the tubes, rotors, and wire mentioned are not obtainable. The stator can be of any convenient size from 3 to 4 in. in diameter and of a length 1/4 in. greater than the diameter of the rotors that are to be used. The diameter of the rotors can be from 1/2 to 1 in. less than the outside diameter of the stator tube. The wire used can vary from No. 20 to No. 26 single or double cotton covered and the number of turns used on the rotors can vary from 30 to 50.

In the illustration, A and B are the aerial and ground posts respectively. C and R are 23-plate Vernier variable

CHRISTMAS is the high-water mark of the broadcasting season. Operas, concerts, plays, vaudeville turns, dance music, lectures, sports—every imaginable form of entertainment is then "in the air." You can enjoy it all if you assemble this exceptionally fine two-stage tickler coil feedback receiver designed by Mr. Calcaterra as the ideal Christmas set.

Front and rear views of the set. The aerial and ground posts are shown in the photograph of the back of the set. The front view is illustrated in connection with Jack Binns' article on page 59.



condensers. D and Q are rheostats, being of 30 ohms resistance for the new 3-volt, 45 ampere tubes or of 5 ohms resistance for any of the other standard tubes.

E is a standard inductance switch provided with nine switch contacts. Switch stops marked S are provided at each end of the contacts to prevent the switch arm from slipping off the outside contacts.

F is a grid leak of 1 or 2 megohms, and G, a grid condenser of .00025 mfd. H, N, and T are tube sockets. The G terminal of the H socket, one of the F terminals of the N socket, and one of the F terminals of the T socket are hidden from view.

I and O are standard audio frequency transformers. J may be a high ratio transformer, but O should be a low ratio one. J and P are double-circuit jacks, while S is a single-circuit jack.

K is the primary winding; L the tickler winding, and M the secondary winding.

U₁, U₂, U₃, U₄, U₅, U₆, and U₇ are binding posts used for battery connections.

The general location of the instruments on the panel and baseboard is clearly shown on the photographs. The size of the panel is 18 by 7 by 3/16 in. The baseboard is 17 by 6 1/4 by 1/2 in. The thickness of the baseboard is not important.

No difficulty in making the proper connections will be experienced if the direc-

tions given below are followed carefully:

A single wire is used to connect the beginning, No. 1, of the primary winding K with the No. 2 or stationary plate terminal of condenser C and the aerial post A. Another wire is used to connect the ground post B with the No. 1 or rotary plate terminal of condenser C. The No. 1 terminal of the condenser is then connected with arm E of the inductance switch by a flexible wire connection.

Now connect each tap of the primary winding K, beginning at the first tap from the beginning or No. 1 end of the winding with its respective switch contact. The end of the winding, marked No. 2, is used as a tap and connected with the last switch point of the inductance switch.

Connect the No. 1 terminal of grid condenser G with the G terminal of socket H. Then connect one end of a wire with the No. 2 terminal of the grid condenser; lead the wire straight up

toward the top of the set until it is at a height on a line with the No. 2 terminal of condenser R and bend it toward terminal and fasten the end of the wire to the terminal.

One of the leads of the secondary coil M is then connected with the wire mentioned in the last paragraph at a point where the wire passes over the rotor shaft.

If a combination grid condenser and leak is not used, terminal of the grid leak could be connected with one terminal of the grid condenser

and the other terminal of the grid leak connected with the other terminal of the grid condenser.

Next connect one of the leads of the tickler rotor winding L with the top spring of jack J and the other lead from the same winding to the P terminal of socket H.

Wiring the Filament Terminals

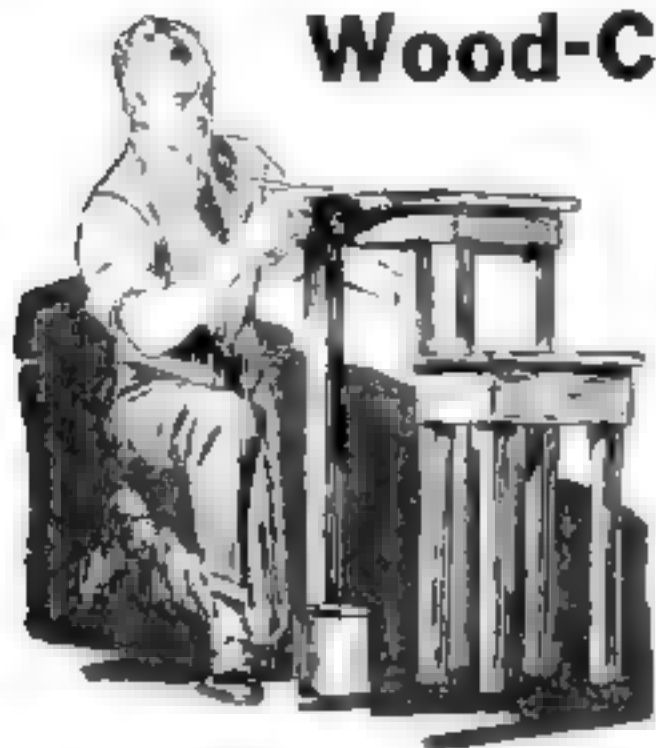
Run a wire connecting one F terminal of each socket with binding post U₂. The wire can be run along the back edge of the baseboard, but make sure that it cannot make contact with any of the other binding posts. If bus-bar wire is used, it should be covered with spaghetti tubing.

The other lead from rotor winding M can now be connected with the wire mentioned in the last paragraph, the connecting wire being run directly back to the wire connecting the F terminals of the sockets or to the F terminal of socket N, to which the wire mentioned in the preceding paragraph is connected.

A wire is then used to connect the No. 1 terminal of condenser R with the F terminal of socket T to which the wire connecting one of the F terminals of each socket with binding post U₂ is connected. An insulated wire, bared only at the

(Turn to page 126)

How You Can Give a Beautiful Finish To Wood-Craft Presents



Small odd pieces of modern furniture make welcome Christmas presents for the home. You yourself can easily make them for your family. There is no particular trick to constructing porch swings, tables, telephone sets, etc.

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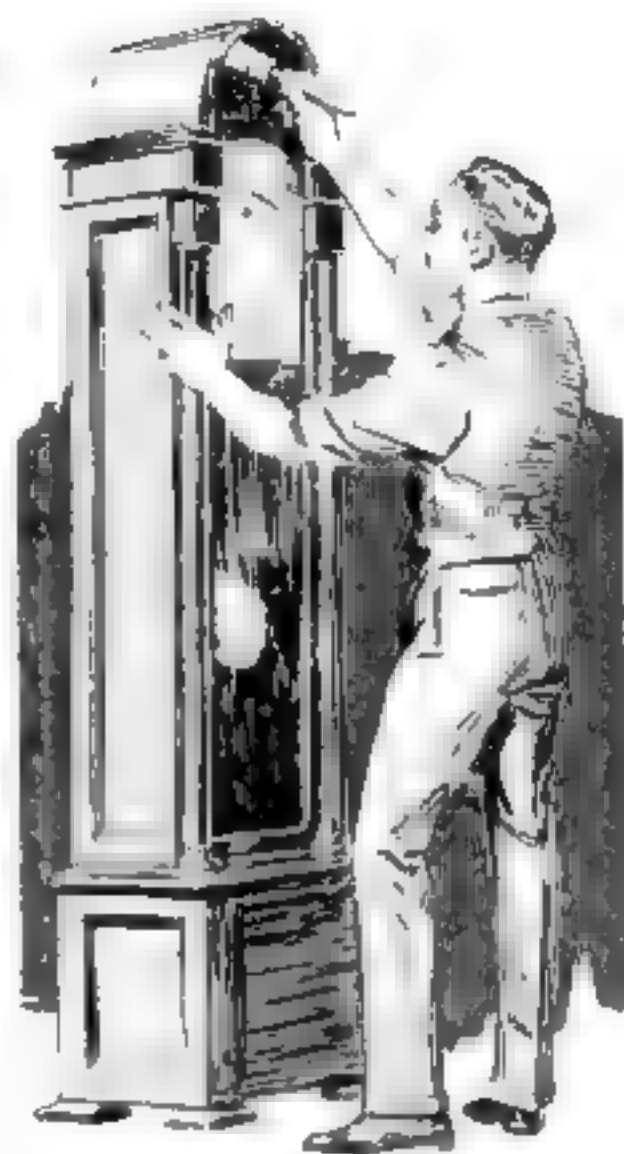
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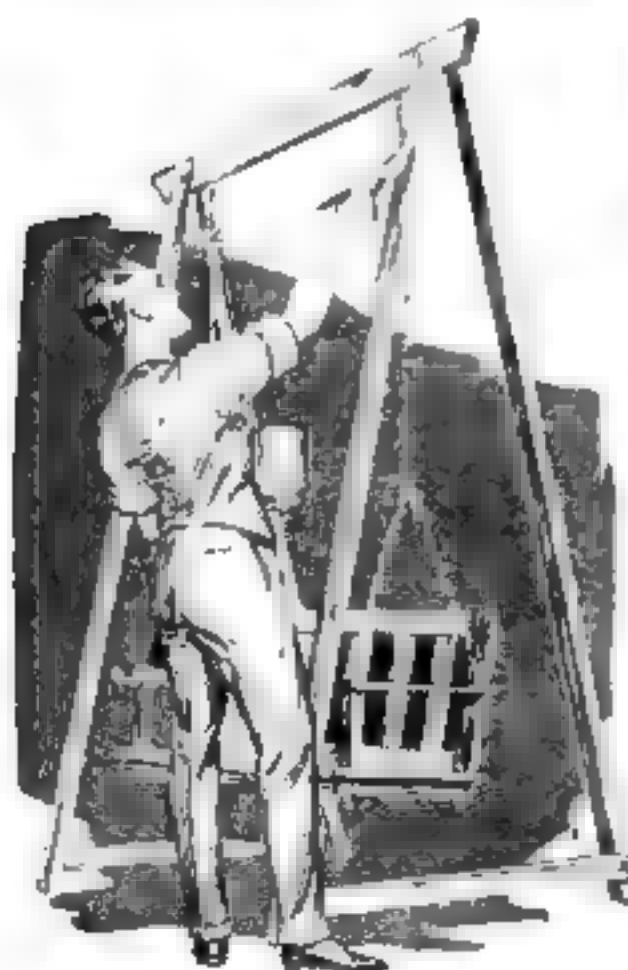
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Better Shop Methods

How Expert Mechanics Save Time and Labor



Short Cuts in Laying Out Machine Work

By Joe V. Romig
Tool Designer and Builder

MANY short cuts are possible in laying out or lining out work in the machine shop. Presumably the regular layer-out and the shop foreman know most of them, but the machine hand or floor hand, no matter how much experience he has had in his particular specialty, often runs into all sorts of difficulties when he is called upon to lay out work.

It goes without saying that any mechanic who attempts lining out for other workmen must be familiar with the use of machine tools in general and have been "through the mill" sufficiently to know just what operations are necessary and their proper order to complete the work in hand.

The main problems in laying out are these: To mark and check the work accurately and speedily, and to do it in such a way that the machinists will be able to follow through the various steps without themselves having to check and measure for obscure markings, uncertain checking points, and unindicated fly lines.

The layer-out can, indeed, do much to simplify the work of the machinist. First of all, the lines and punch marks should be easily distinguishable. On rough work this can be accomplished by coating the metal with a whitewash composed of equal parts of lime and powdered chalk mixed with water to a thin paste and spread over the work with a soft bristle brush.

On extremely accurate and highly polished tool work, it is more desirable to give the surfaces a coating of copper.

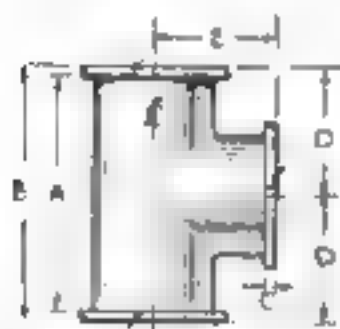


Fig. 2. Diagram illustrating layout of flanged casting.

This is done by applying a solution of blue vitriol and distilled water, care being taken first to remove all grease and dirt. The copper is easily removed after the completion of the work by rubbing the surface with fine emery paper or cloth.

For laying out, the machinist should become accustomed to having a particular set of tools available at his bench so that he will not have to search through his tool chest after he has started. There should be light and medium weight hammers, dividers from 4 to 12 in., micrometers, trammel sets suitable for both small and

large diameter work, with suitable divider and caliper feet and also a set of ball feet for work with holes in the center, and a surface gage. Then, too, he should have at hand an accurate tape line, several scales of different lengths, scribers, prick punches, squares, and a bevel protractor,

Fig. 1. Laying out the horizontal lines. The piece is then turned for marking the vertical lines.



as well as a center head and other tools.

In all laying out, the surface plate plays a most important part. On it the work must be blocked up perfectly true and level.

A careful study of the blueprints must be made and the rough dimensions of the work checked to see that no great discrepancy exists. If any part of the casting or forging is scant of metal, the lining out must be very true to save the stock. Often when the casting or forging is faulty on one side, the lining out should be such as to take off as much metal on the faulty side as possible.

Surfacing Cut Sometimes Necessary

In iron castings, where there is plenty of stock for finishing but the metal appears to have air holes, it is well to have a surfacing cut made first to show how deep the defects are.

Since the starting points in laying out a piece of work are the under side of flanges, the outside of bodies, and other surfaces that are not to be machined, these should be checked carefully and all differences should be divided so as to make uniform the thickness of flanges and other parts. Thus in Fig. 2 the dimension A is first checked and established so that the flanges at the extremities of B will be equal.

Then comes the determination of all center lines. The master horizontal center line is scribed all around the work with a gage. If there are a number of

bosses, hubs or flat surfaces to be worked to accurate distances from the master center line, their distances are scribed horizontally before turning the work, as in Fig. 1.

The work is next turned so that the master center line runs vertically to the surface plate. The work is blocked up true as before and a line is scribed across to serve as a reference line from which the remaining lines can be located.

On all lines marked out make light center punch marks at short intervals so that if the lines are rubbed out, the punch marks will serve instead. Center punches, it might be added, should be long and slender at the pointed end so that they will not obstruct the view of the lines that are being punched.

When a hollow casting is to be machined, it is customary to insert a wooden plug and scribe arcs on it from the edges to mark the center. A clearer intersection can be obtained if a square piece of tin is fastened to the plug at the center. This is done by bending over two corners of the tin at right angles to the surface and driving these points into the soft wood. The arcs on the tin will be more clearly defined than on wood.

From the center thus established it is possible to run a fly line; in fact, any experienced shop foreman will insist that all machine workers run a fly line on every piece they have to turn. This facilitates the program of the work after it leaves their hands. It requires but a minute extra when the work is still in the lathe, but saves much time later, as well as insuring greater accuracy. When in the lathe the line A is cut with a fine pointed tool as shown in Fig. 3.

Referring to Fig. 2, the distance B is projected from the previously established

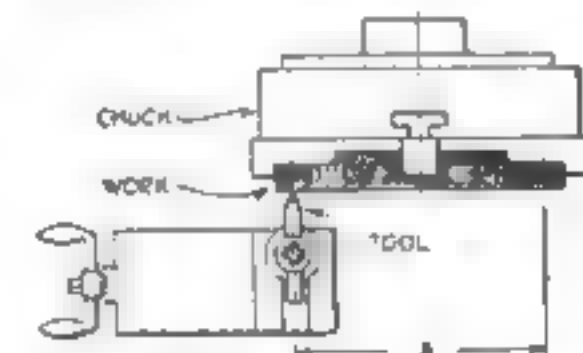


Fig. 3. Running a fly line on a circular piece of work in the lathe with a fine pointed tool.

center line. Then the distances D are laid out, giving the center line of the side flange. Such dimensions as C, the thickness of the single flange, are neglected entirely when both surfaces of the flange do not require machining. While the piece above described is a simple one, it serves

(Turn to page 84)

Choose your 'mike' CAREFULLY

IF there's one tool in your kit that should be right in every detail it's the Micrometer.

Get a Starrett and you can't go wrong. Here are some of the features that help to explain the preference of two generations of machinists for these fine Micrometers.

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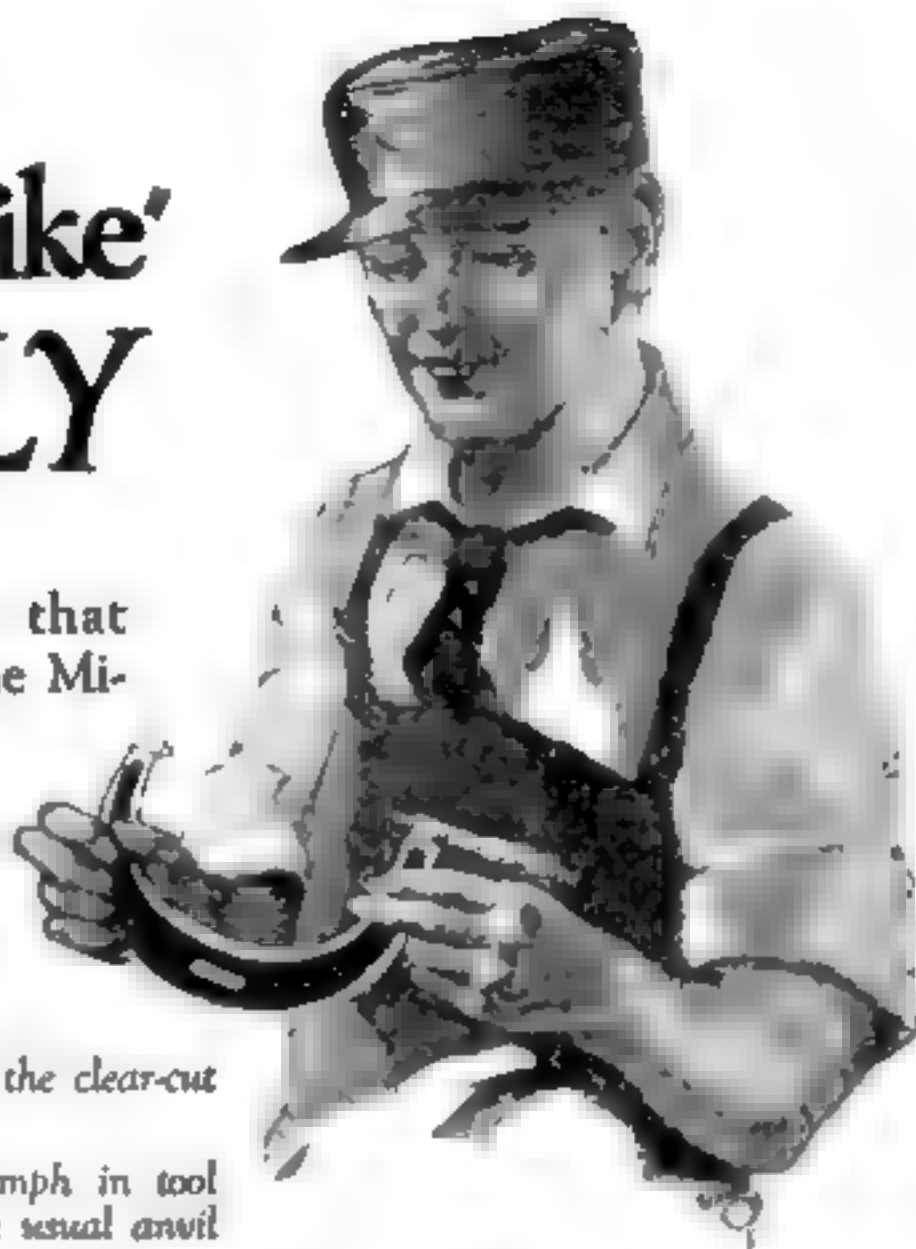
Starrett design, workmanship and finish assure you of a Micrometer that is not easily sprung, is simple to adjust, and is good for years and years of reliably accurate service. You can't go wrong on a Starrett.

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ATHOL, MASS.

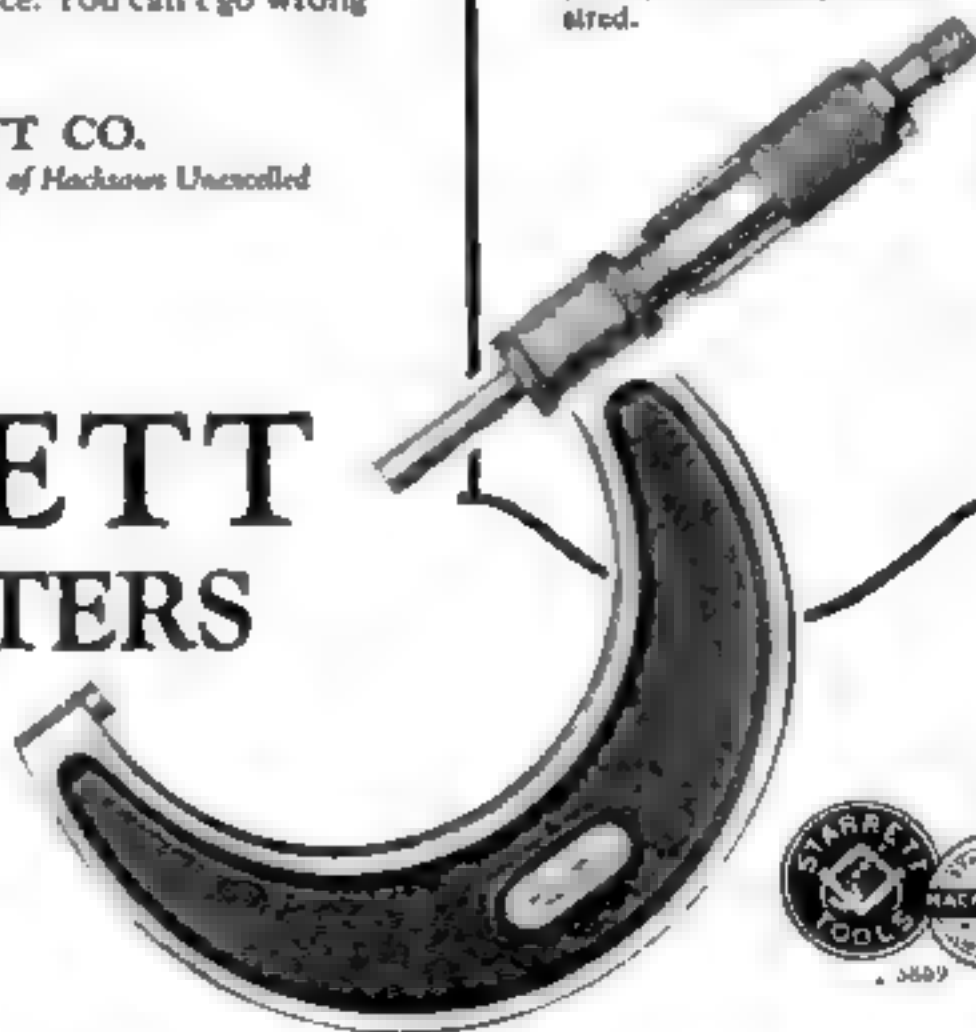
USE STARRETT MICROMETERS

The Starrett Catalog will help you select the Micrometer best suited to your requirements. Mailed free—ask for No. 22 "W".



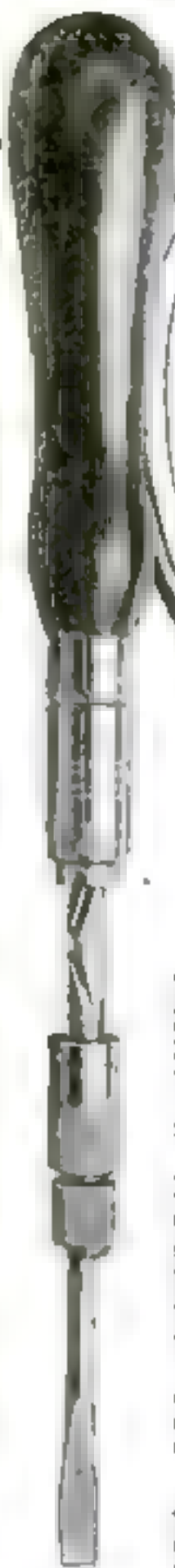
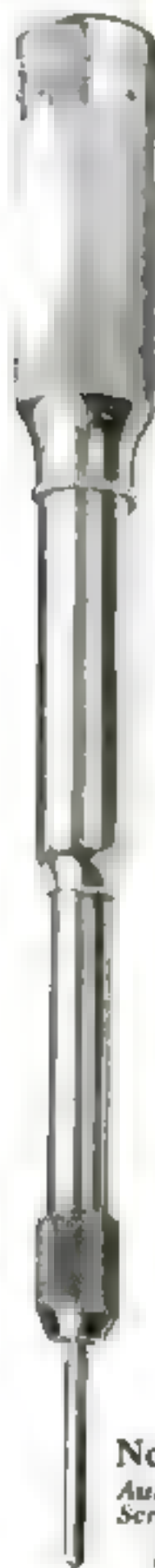
STARRETT MICROMETER No. 226

These calipers meet the demand for accurate gages at a low price. Supplied singly or in sets (combinations from 1 to 6 inches) as desired.



No. 185

Automatic
Drill—
"Mr. Punch."
Length, 20 inches



No. 111

Automatic
Screw-Driver
Length,
extended,
18 inches



Give him a tool for Christmas

HERE are two of the best tools made—for handy men, for men who work with tools, for boys who build things.

Each is packed in a Special Gift Box—all ready to present on Christmas morning.

The Goodell-Pratt Automatic Drill, "Mr. Punch," bores holes—any size from $\frac{1}{16}$ to $\frac{1}{4}$ of an inch. In the handle are eight different size drill points. You get the one you want by turning the top cap. Fit the point into the chuck. Then you push and Mr. Punch twists. The hole is made in a jiffy.

The Goodell-Pratt No. 111 Automatic Screw Driver also turns work into fun. You just push, and the screw sinks in. Three tool-steel blades—hardened, tempered and polished—are included.

Ask Your Hardware Dealer

These Goodell-Pratt Christmas Gifts are sold by hardware stores everywhere. If your dealer hasn't them, order direct from us. Price of each tool is \$2.50.

Mr. Punch says: "Do your Christmas Shopping at the hardware stores."

GOODSELL-PRATT COMPANY
GREENFIELD, MASS., U. S. A.

Toolsmiths



Laying Out Machine Work

(continued from page 83)

to show the sequence in which the operations of laying-out are to be performed.

In general it may be stated that individual parts are usually laid out complete in themselves. When many pieces are to be made alike, a templet is commonly used and the work is done in jigs and fixtures that are themselves laid out to conform to the templet. The templates are made of thin sheet plate.

When locating points on the circumference of the fly line, it is often found that an accumulation of errors caused by the slipping of the divider points and the springing of the legs gives an appreciable difference in location. In fact, if an attempt at division is made by spacing around the circle with consecutive positions of the dividers, no two measurements will agree exactly, even though the workman may use extreme care. The better way is to divide the circumference into fours with two lines at right angles through the center and then re-divide into eighths and sixteenths in the same way until the proper locations are arrived at. Often this will not give the proper number of divisions and the start must be with sixths. This can be accomplished by using the radius as a chord on the dividers for dividing into sixths and proceeding as before. A table of chords is given in most handbooks and will be found invaluable in obtaining accurate results.

Disks of lead are sometimes used to plug holes so that the center can be marked for scribing lines with the dividers. The disks can be compressed or stretched to fit.

Marking Holes for Drilling

Holes that are to be drilled are often laid out with two or three circles inside the drill size circle. These circles are punched at several places, as the oil used on the drill dims the scribed lines. The advantage of the extra circles is in showing if the drill is running out before it has cut to its full diameter. If it is running out, it can be coaxed back by means of a chisel.

Many machinists find difficulty when it comes to lining out large work, for then the piece must be leveled up on an accurate surface plate and a level must, in part, take the place of the square. Be sure that the surface plate is not mauled. Moreover, the plate itself should be carefully leveled.

Plumb bobs are used to level up clumsy work. Cylindrical work is first centered and all other points are squared or leveled from these centers. After this the plumb bob is used to transfer the center to the opposite face. When using a long straight edge to transfer through the plumb bob to a lower surface, it is good practice to clamp it to the upper flanges. Any straight edge or square is liable to move unless it is clamped in a true and accurate position.

Rather than project an angle from a small bevel protractor with a scale or straight edge held against the leg, lay out the bevel on a circle and divide a quarter

(Turn to page 86)

GOODELL- PRATT

1500 GOOD TOOLS



Crossroads of Conversation

Could the telephone directory in the hands of each subscriber be revised from hour to hour, there would be no need for the information operator. But even during its printing and binding, thousands of changes take place in the telephone community. New subscribers are added to the list. Old ones move their places of business or of residence.

Though their names are not listed on the directory, these subscribers must be connected by the highways of speech with all others in the community. To supplement the printed page, there must be guides at the crossroads of conversation.

Such are the information operators, selected for their task because of quickness and accuracy, courtesy and intelligence. At their desks, connected with the switchboards in central offices, they relieve the regular operators from answering thousands of questions about telephone numbers that would otherwise impede the rendering of service. If they are unnecessarily asked for numbers already in the directory, service is retarded.

"Information" stands for the most complete utilization of telephone facilities.



"BELL SYSTEM" AMERICAN TELEPHONE AND TELEGRAPH COMPANY AND ASSOCIATED COMPANIES

*One Policy, One System, Universal Service,
and all directed toward Better Service*



Save Your Tools and Save Money!

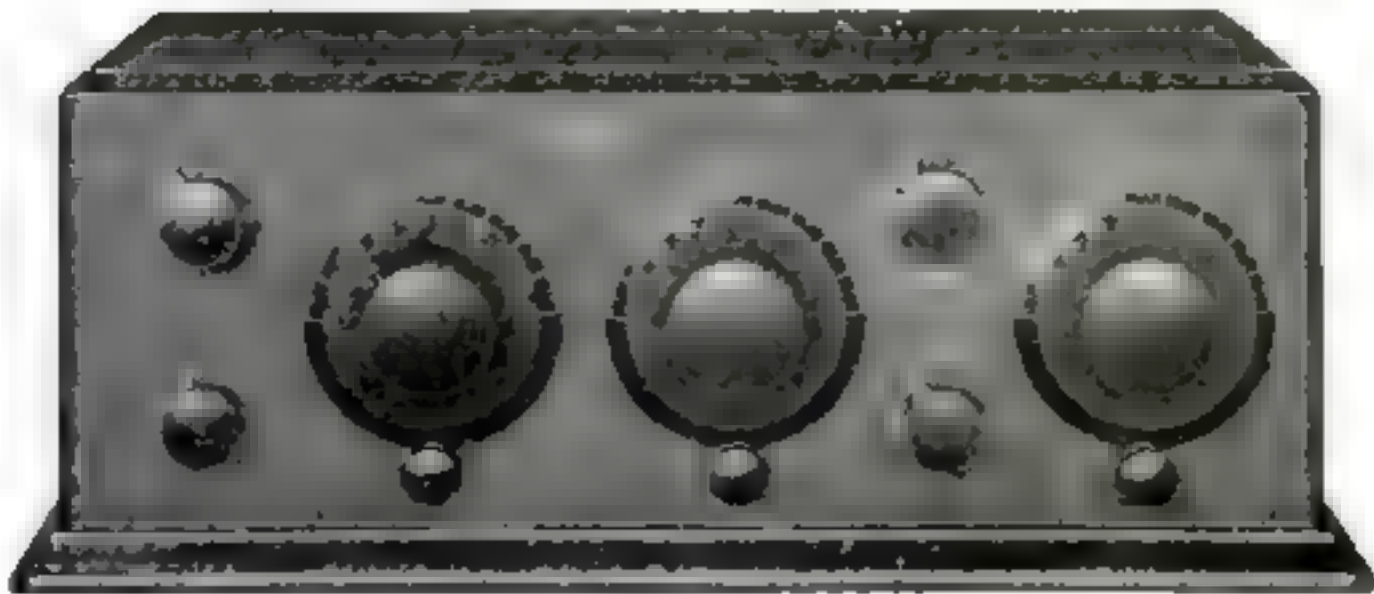
A place for every tool and every tool in a GERSTNER Case will save both money and tools. A style, size and price to suit all trades. Catalog free.

H. Gerstner & Sons
245 Columbia St., Dayton, Ohio

\$3 Cash Buys Typewriter



Selections Only 15 Monthly
No. 35 to 40, 45 to 50, 55 to 60, 65 to 70, 75 to 80, 85 to 90, 95 to 100, 105 to 110, 115 to 120, 125 to 130, 135 to 140, 145 to 150, 155 to 160, 165 to 170, 175 to 180, 185 to 190, 195 to 200, 205 to 210, 215 to 220, 225 to 230, 235 to 240, 245 to 250, 255 to 260, 265 to 270, 275 to 280, 285 to 290, 295 to 300, 305 to 310, 315 to 320, 325 to 330, 335 to 340, 345 to 350, 355 to 360, 365 to 370, 375 to 380, 385 to 390, 395 to 400, 405 to 410, 415 to 420, 425 to 430, 435 to 440, 445 to 450, 455 to 460, 465 to 470, 475 to 480, 485 to 490, 495 to 500, 505 to 510, 515 to 520, 525 to 530, 535 to 540, 545 to 550, 555 to 560, 565 to 570, 575 to 580, 585 to 590, 595 to 600, 605 to 610, 615 to 620, 625 to 630, 635 to 640, 645 to 650, 655 to 660, 665 to 670, 675 to 680, 685 to 690, 695 to 700, 705 to 710, 715 to 720, 725 to 730, 735 to 740, 745 to 750, 755 to 760, 765 to 770, 775 to 780, 785 to 790, 795 to 800, 805 to 810, 815 to 820, 825 to 830, 835 to 840, 845 to 850, 855 to 860, 865 to 870, 875 to 880, 885 to 890, 895 to 900, 905 to 910, 915 to 920, 925 to 930, 935 to 940, 945 to 950, 955 to 960, 965 to 970, 975 to 980, 985 to 990, 995 to 1000, 1005 to 1010, 1015 to 1020, 1025 to 1030, 1035 to 1040, 1045 to 1050, 1055 to 1060, 1065 to 1070, 1075 to 1080, 1085 to 1090, 1095 to 1100, 1105 to 1110, 1115 to 1120, 1125 to 1130, 1135 to 1140, 1145 to 1150, 1155 to 1160, 1165 to 1170, 1175 to 1180, 1185 to 1190, 1195 to 1200, 1205 to 1210, 1215 to 1220, 1225 to 1230, 1235 to 1240, 1245 to 1250, 1255 to 1260, 1265 to 1270, 1275 to 1280, 1285 to 1290, 1295 to 1300, 1305 to 1310, 1315 to 1320, 1325 to 1330, 1335 to 1340, 1345 to 1350, 1355 to 1360, 1365 to 1370, 1375 to 1380, 1385 to 1390, 1395 to 1400, 1405 to 1410, 1415 to 1420, 1425 to 1430, 1435 to 1440, 1445 to 1450, 1455 to 1460, 1465 to 1470, 1475 to 1480, 1485 to 1490, 1495 to 1500, 1505 to 1510, 1515 to 1520, 1525 to 1530, 1535 to 1540, 1545 to 1550, 1555 to 1560, 1565 to 1570, 1575 to 1580, 1585 to 1590, 1595 to 1600, 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to 2320, 2325 to 2330, 2335 to 2340, 2345 to 2350, 2355 to 2360, 2365 to 2370, 2375 to 2380, 2385 to 2390, 2395 to 2400, 2405 to 2410, 2415 to 2420, 2425 to 2430, 2435 to 2440, 2445 to 2450, 2455 to 2460, 2465 to 2470, 2475 to 2480, 2485 to 2490, 2495 to 2500, 2505 to 2510, 2515 to 2520, 2525 to 2530, 2535 to 2540, 2545 to 2550, 2555 to 2560, 2565 to 2570, 2575 to 2580, 2585 to 2590, 2595 to 2600, 2605 to 2610, 2615 to 2620, 2625 to 2630, 2635 to 2640, 2645 to 2650, 2655 to 2660, 2665 to 2670, 2675 to 2680, 2685 to 2690, 2695 to 2700, 2705 to 2710, 2715 to 2720, 2725 to 2730, 2735 to 2740, 2745 to 2750, 2755 to 2760, 2765 to 2770, 2775 to 2780, 2785 to 2790, 2795 to 2800, 2805 to 2810, 2815 to 2820, 2825 to 2830, 2835 to 2840, 2845 to 2850, 2855 to 2860, 2865 to 2870, 2875 to 2880, 2885 to 2890, 2895 to 2900, 2905 to 2910, 2915 to 2920, 2925 to 2930, 2935 to 2940, 2945 to 2950, 2955 to 2960, 2965 to 2970, 2975 to 2980, 2985 to 2990, 2995 to 3000, 3005 to 3010, 3015 to 3020, 3025 to 3030, 3035 to 3040, 3045 to 3050, 3055 to 3060, 3065 to 3070, 3075 to 3080, 3085 to 3090, 3095 to 3100, 3105 to 3110, 3115 to 3120, 3125 to 3130, 3135 to 3140, 3145 to 3150, 3155 to 3160, 3165 to 3170, 3175 to 3180, 3185 to 3190, 3195 to 3200, 3205 to 3210, 3215 to 3220, 3225 to 3230, 3235 to 3240, 3245 to 3250, 3255 to 3260, 3265 to 3270, 3275 to 3280, 3285 to 3290, 3295 to 3300, 3305 to 3310, 3315 to 3320, 3325 to 3330, 3335 to 3340, 3345 to 3350, 3355 to 3360, 3365 to 3370, 3375 to 3380, 3385 to 3390, 3395 to 3400, 3405 to 3410, 3415 to 3420, 3425 to 3430, 3435 to 3440, 3445 to 3450, 3455 to 3460, 3465 to 3470, 3475 to 3480, 3485 to 3490, 3495 to 3500, 3505 to 3510, 3515 to 3520, 3525 to 3530, 3535 to 3540, 3545 to 3550, 3555 to 3560, 3565 to 3570, 3575 to 3580, 3585 to 3590, 3595 to 3600, 3605 to 3610, 3615 to 3620, 3625 to 3630, 3635 to 3640, 3645 to 3650, 3655 to 3660, 3665 to 3670, 3675 to 3680, 3685 to 3690, 3695 to 3700, 3705 to 3710, 3715 to 3720, 3725 to 3730, 3735 to 3740, 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Type RB-2

Price \$135.00

Announcing a New Paragon Receiver —the Ideal Family Christmas Gift

What could be a more wonderful Christmas gift than a radio receiving set that you *know* is the best that money can buy? Think of the pleasure it will bring to every member of the family, young and old. Think of the happiness it will mean to you every night of the year.

PARAGON Radio Receivers are famous as the three circuit pioneers which have proved their superiority by eight years of practical operation.

The newest PARAGON, pictured above, is the last word in sensitivity and selectivity. The superiority of this type over all other classes of receiving equipment has been thoroughly proved by the long list of distance records which it holds. Included in these records are the reception of the first trans-continental amateur message, the reception of the first trans-Atlantic message, and the unbroken communication which it has maintained with the McMillan Expedition frozen in above the Arctic Circle.

The operation of the new PARAGON

receiver is so materially simplified that even in the hands of a novice it equals in every way the performance of the older type in the hands of an expert.

You need only switch on the tubes, set the calibrated dial and turn two other dials that automatically give you their proper position for the reception of any given broadcasting station.

In appearance it is an addition to any home. All cabinet work is of mahogany with a brown mahogany finish. All metal parts showing, inside as well as outside of the cabinet, are nickel plated. 98% of the wiring is invisible. The whole outfit is compact, neat, solidly built, and finely finished. It is the ideal Radio receiver and the ideal holiday gift.

An illustrated Catalog of Paragon Radio Products is yours for the asking.

Dealers: We believe in the proper distribution of Paragon Radio Products. Our Exclusive Distributors are particularly interested in territorially protected dealers, who will concentrate, select and serve the consumer in the sale of Paragon Radio Receivers. If interested, write us for details.

ADAMS-MORGAN CO., 18 Alvin Avenue, Upper Montclair, N. J.

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS

Another Addition to our Ratchet Screw Driver Line No. 59

YOU hear people say, "I can't seem to find a ratchet screw driver strong enough for the kind of work I do." Maybe you've said it yourself. If so, don't waste time. Stop in at the nearest hardware store and ask the man behind the counter to show you this new Millers Falls Ratchet Screw Driver No. 59.

It is made especially for electricians, gunsmiths, mechanics and others whose work demands a screw driver more rugged than the regular type.

Same design as our popular No. 63 line of ratchet screw drivers. Your kit isn't complete without this tool. The more you use it, the better you'll like it.

Specifications:

Ratchet Pawls—Tool Steel.

Ratchet frame—cold rolled steel.

Handle—hardwood, highly polished. Shaped to hand. Thumb rest at lower end.

Diameter of ratchet— $\frac{7}{16}$ in.

Length of blade— $1\frac{1}{4}$ in.

Ratchet springs—spring steel.

Blade—highest quality screw driver steel, hardened and tempered.

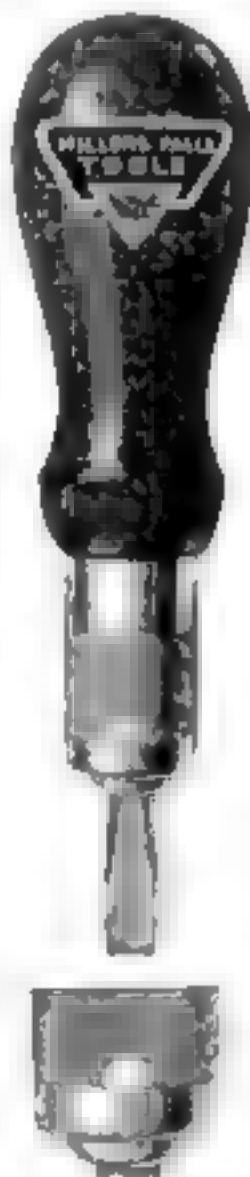
Exposed metal parts polished and nickel plated.

Diameter of blade— $\frac{1}{4}$ in.

Cabinet type.

Length overall— $6\frac{1}{4}$ in.

Ratchet operates either to right or left by turning shifter ring. At 0 it becomes a solid screw driver.



MILLERS FALLS COMPANY

Millers Falls, Mass.

Manufacturers of Carpenters' Tools, Hack Saws and Automobile Tools

**MILLERS FALLS
TOOLS**

SINCE
1868

Tilting Table for Milling Tapers

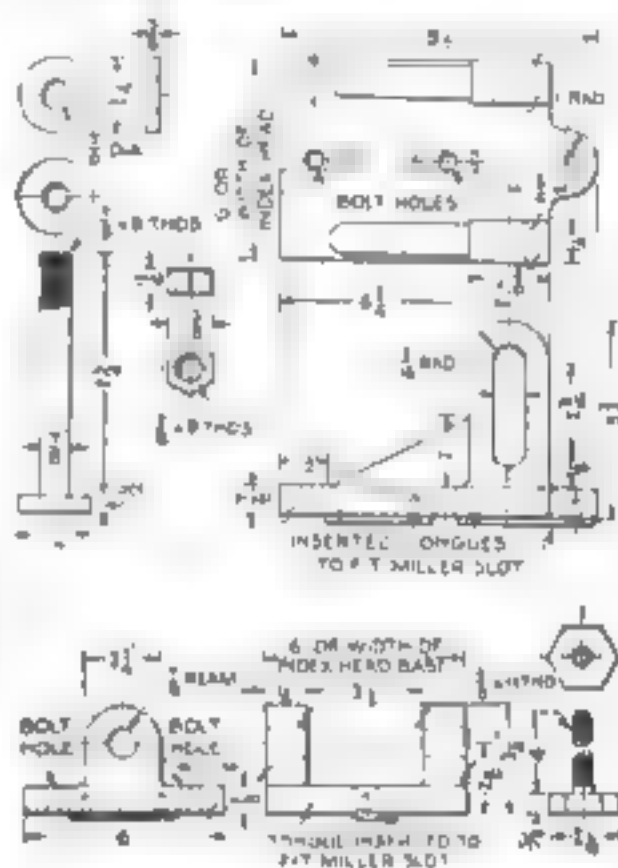
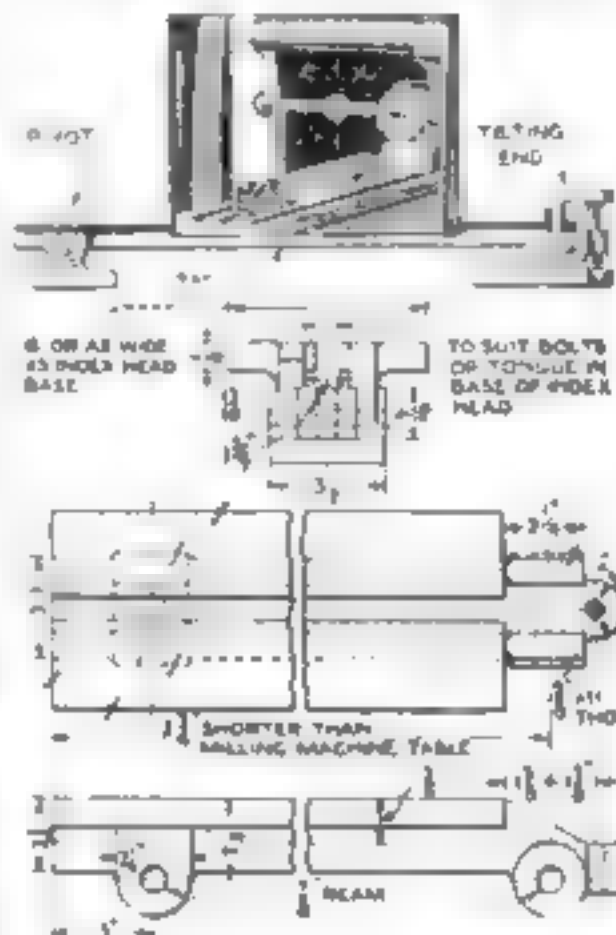
AS THE milling machine has no arrangement by which the table can be thrown out of the horizontal, it is often useful to have a special tilting table for tapered work, such as taps, reamers, and the like.

The table should be as wide as the index centers with which it is to be used. By bolting irons to the table, all kinds of tapered work can be done. The angle of tilt is determined accurately by means of a sine bar. If the taper wanted is out

of range of the elevating screw, one side of the table can be blocked up.

The edge of the table has been left clear of the rib usually found on tilting tables; this makes it easier to clamp work to it. Another improvement is the finishing of the under edges parallel to the top.

While the table shown here is made with castings, smaller tables are made of machine steel.



The tilting table set up on a milling machine and details of the parts

A Gift for Yourself

WHY not give yourself a year's subscription to **POPULAR SCIENCE MONTHLY**?

You know that in **POPULAR SCIENCE MONTHLY** you will get the most fascinating reading published, and will get it promptly every month delivered to your home.

If you also give a year's subscription to some good friend, we will make a very attractive special Christmas offer.

You can have **POPULAR SCIENCE MONTHLY** delivered to a friend for one year at a cost of \$2.50—or even less if you order two subscriptions as follows.

One Subscription \$2.50

Two subscriptions only \$4.00

One of the subscriptions may be your own, or both may be gift subscriptions. If you wish more than two subscriptions add \$2.00 for each additional subscription.

A gift card announcing your gift will be sent to each friend to whom you give **POPULAR SCIENCE MONTHLY**. Send your order early—use the order blank below or if you prefer an ordinary sheet of paper Write the address plainly

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York

For the \$ enclosed please send **POPULAR SCIENCE MONTHLY** for one year to

1. Name
Address
2. Name
Address
Ordered by
Address

Dec. '21



Guaranteed for Life

FREE 10-Piece Kitchen Set
White Enamel

No Money Down

Wonderful 32-Piece Aluminum Set complete with 2 Marshall and Doughnut Cutters, 3 Large Boiling and Rice Pans, Combination Teakettle and Rice Boiler with Hot Saucepot Set with Lid, Dipped 4-Quart Measuring Cup, Hot Water 2 Pint Glass Combination Ladle Set, Tea or Coffee Steamer, Fry Pan also rubber set of 5 pieces, Washed 11 sets of aluminum combination Pressing Mats, Canvas for top Combination Linen Cabinet, Folding Pan, Tapered Pan, Lollipop, Sugar, Corn Popper, Steamer Set, Double Boiler.

Not a penny now. Just mail the coupon and Hartman will send you this splendid complete 32-piece Aluminum Cooking Set, and also the Free 10-piece Combination Kitchen Set. When the goods arrive make first payment of only \$2.00 on the Aluminum Set. Pay nothing for the

Kitchen Set—it is FREE. Use both sets 30 days on Free Trial, and if not more than satisfied, send them back and we will refund your money and pay transportation both ways. If you keep them, pay for the Aluminum Set, a little every month. Keep the Kitchen Set as a gift from Hartman.

Complete 32-Pc. Aluminum Set and FREE Kitchen Set

This is Hartman's famous special, selected set of heavy gauge Aluminum Ware—a complete cooking outfit, light to handle, easy to clean, always bright as silver. Will never chip, crack or rust. So durable that we guarantee it for life. 32 utensils—everything you need for baking, boiling, roasting, frying. Just read the list above. You want and need everything there. Your kitchen is not complete without them. You really can't appreciate this splendid set until you see and use it. Then you will realize what a wonderful bargain it is. And without a penny's cost—absolutely free—you get a Combination Kitchen Set which gives you 10 utensils with white handles—all hang in a row—where you can reach them easily.

Nearly a Year to Pay Hartman gives the world's most liberal terms and the world's greatest values in dependable merchandise, and this offer proves it. You pay only \$2.00 and postage on arrival (this on the Aluminum Set—not a penny to pay at any time on the Kitchen Set). Then, if after 30 days' trial you decide to keep it, pay a little every month. Take nearly a year to pay.

FREE 10-PIECE KITCHEN SET

Not a penny to pay for this set. You get it absolutely free with Aluminum Set.

Potato Masher
Steaming Spoon
Measuring Spoon
Ice Pick
Egg and Cream Beater
Can Opener
Vegetable and Pan Scrap
Fork
Egg and Cake Turner
Wafle Maker

All have white enameled handles and hang on wall rack, keeping them conveniently at hand.

HARTMAN FURNITURE & CARPET CO.
Dept. 5852 Chicago, Ill.

Send the 32-Piece Aluminum Cooking Set No. 47723367, Price \$19.95, and 10-Piece Kitchen Set. Will pay \$2 and postage on the Aluminum Set on arrival. Kitchen Set is FREE. I also to have 30 days' free trial. If not satisfied, I will ship both sets back. If I keep them, I will pay you \$2 monthly until the price of the Aluminum Set \$19.95 is paid. This promise with you until final payment is made.

Name _____
Occupation _____
R. F. D. Box No. _____
or Street and No. _____
Post Office _____ State _____
If shipping point is different from Post Office office fill in State below
Send shipment to _____



FREE Bargain Catalog and FREE GIFTS

This great 128-page book offers the world's greatest bargains in home furnishings, jewelry and farm machinery. You will find an entire month's worth of bargains in this catalog. It is absolutely free.

WONDERFUL GIFTS
Simply reply to this coupon. A Glassware, Silverware, Table Cloth, Napkins, etc. Free with purchase of \$5.00 or more. "Let Hartman Feather Your Nest!"

Order by No. 417EMA7. Price for Aluminum Set, \$19.95. No money down, \$2.00 and postage on arrival. Balance \$2.00 monthly. 10-Piece Kitchen Set is FREE.

Don't hesitate. Send at once, while this offer holds good. Not a penny's risk. Order NOW while you can get the Kitchen Set Free.

Mail the Coupon
HARTMAN FURNITURE & CARPET CO.
Dept. 5852 Chicago, Ill.



The micrometer head should fit snugly in the hole provided for it, but the tension stop screw should be adjusted so that it



The line consists of Bit Braces, Auger Bits, Squares, Chisels, Hammers, Hatchets, Pliers, Monkey and Pipe Wrenches, Angle Wrenches, Screw Drivers, Snips, Compasses, Pruning Shears, Dividers, Calipers, Pincers, Soldering Coppers, Nail Sets, and many other small tools.

Booklets covering our important lines are available for free distribution.

PEXTO TOOLS are carried by practically all progressive dealers.



**The Peck, Stow & Wilcox
Company**
Southington, Conn., U.S.A.

The distance between the block and stop body, as well as the notch in the block, should be designed to fit the lathe ways. When the draw screw is turned to the right, the block is drawn down the 12-degree incline and clamps the stop in place. The micrometer screw can then be turned so that the proper travel limit will be established when the stop screw on the carriage bears against the head. Care must be taken not to bring the lathe carriage against the micrometer with too much force.

Flexible Gas Heating Torch

FOR bench use the gas burning torch illustrated has several advantages. Because of the direct connection through a flexible metal tube with the gas line, the torch can be lit more quickly than a regular blowtorch. The flame is adjusted through the spreader and the intensity is controlled jointly through the gas



petcock and the air inlet valve of the torch itself. The body is a brass tube fitted to a wooden handle with small thimbles. The air inlet is a sleeve fitting the center tube snugly, holes being drilled through both. The flame spreader is made of one piece of steel, as shown.

Every man has a hobby (hobby) which he enjoys either
 pleasure or profit out of it. Although a few get more
 profit from work than from their hobby, the man whose hobby is work
 gets a kind of satisfaction and pleasure from his work
 and gets more pleasure and more
 profit from work than from his hobby.

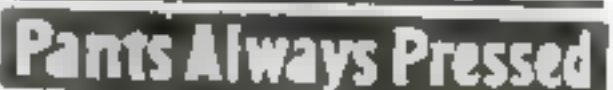
The Pater Beach Marline shows three conditions of marlines in use. The white drill is under pressure and holds its square in its stock with ease and does not let the marline stretching, etc. Good for a fly as he can let his counter. It is a good idea to use in case of thousands of shops, both indoors and outdoors.

As a girl, nothing could be more appreciated by the boys on the way who take to work with them and make it will bring some of the best and some of the best.

Sold on a positive guarantee. Every Silver Dollar Machine is sold with a ten day trial money back guarantee.

The complete line of Baby Dolls Beach Markings including Baby Doll Beach Name, Beach Hand Name, Beach Number, Beach Line, Beach Joiners and Markers. We're today for completely distinctive markings on any of these markings.

W. S. & J. E. Bailey, Dept. P. & L. Toledo, Ohio



1. The first part of the document is a list of names and their corresponding addresses. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.



The "A" Battery's Power in Your Radio Receiving Set

THIS IS NUMBER TWO OF A SERIES

THE sole purpose of the "A" Battery in your Radio Receiving Set is to furnish current to heat the filaments of the tubes.

And this can be done satisfactorily only by an "A" Battery that supplies an adequate steady current.

Anticipating the popularity of the dry cell tube in Radio, and realizing that it required a Dry Cell capable of standing up under service conditions differing from what dry cells are called upon to meet in other fields, the National Carbon Company developed the Eveready Radio Dry Cell specifically for this new use.

A dry cell gives its maximum service only when designed especially for the work it is intended to perform. There are for dry cells several uses which are so alike that one type of cell serves for all. This is the field covered by the ignition or general purpose dry cell.

The conditions encountered in Radio are different from the conditions grouped together under the term "general purpose." And while the general purpose dry cell performs well as an "A" Battery, it was found possible to produce a Dry Cell "A" Battery capable of delivering more service on Radio loads.

Thirty years of dry cell experience and an immense research organization resulted in the superior Eveready Radio Dry Cell. One of the outstanding features of this special cell is that while it will last much longer when used as an "A" Battery, it is no larger than the standard dry cell.

The increased service life of the Eveready Dry Cell "A" Battery greatly offsets the slight increase in cost; so this battery is not only the best, but it is the most economical you can buy. "The Story of Eveready Dry Cell Radio 'A' Batteries," which tells how to use Dry Cells to the greatest advantage with the various dry cell tubes now available, will be sent to you free on request.

* * * *

The "A" Battery gives power to your Radio Receiving Set. Eveready Batteries—especially made for Radio—serve better, last longer, give better results.

Note: This is number 2 of a series of informative advertisements which will appear in this magazine. They are designed to help users get the most out of their Batteries and their Radio Sets. If you have any battery problem, write to G. C. Furness, Manager Radio Division, National Carbon Company, Inc., 116 Thompson Ave., Long Island City, N. Y.



POWER for Your Radio Set

Eveready Dry Cell
Radio "A" Battery
(No. 7111)

Directions and wiring diagrams on the jacket tell just how to use this battery with the different dry cell tubes.

This special Radio Cell is also available in two and four cell multiple batteries for receiving sets employing from two to four WD-11 or WD-12 tubes.

Other Radio Batteries

Eveready Storage "A" Batteries—best suited for filament heating of all Radio Tubes not especially designed for dry cells. The quality storage battery with the long life plates, \$15 to \$20.

Eveready "B" Batteries—the life of your Radio.

Eveready "Three" Battery—3 cells, 3 purposes.

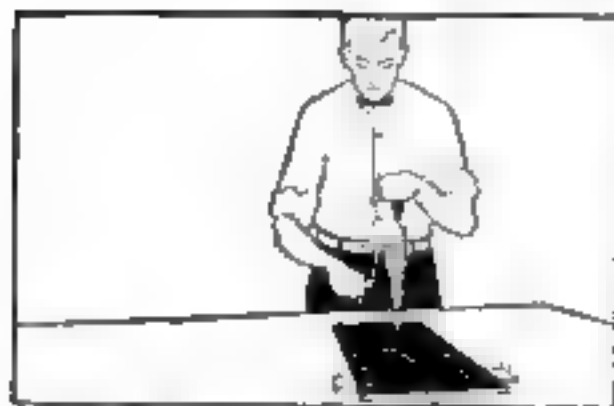
Manufactured and guaranteed by

NATIONAL CARBON COMPANY, Inc.

EVEREADY

Radio Batteries

—they last longer



The Supreme Insulation
RADION
 Panels
 are easiest
 to drill, saw
 or engrave
 with simple
 tools at
 home

18 Stock Size Panels

Furnished in 18 stock sizes.

6 x 7	7 x 21
6 x 10 $\frac{1}{4}$	7 x 24
6 x 14	7 x 48
6 x 21	9 x 14
7 x 9	10 x 12
7 x 10	12 x 14
7 x 12	12 x 21
7 x 14	14 x 18
7 x 18	20 x 24

Radion, being an insulation material especially made for wireless use, has the lowest phase angle difference, lowest dielectric constant, highest resistivity and supreme moisture, gas and acid repelling properties.

Send 15c for sample test piece of RADION panel 2x3 in. Try it with your own drill.

American Hard Rubber Co.
 11 Mercer St., New York

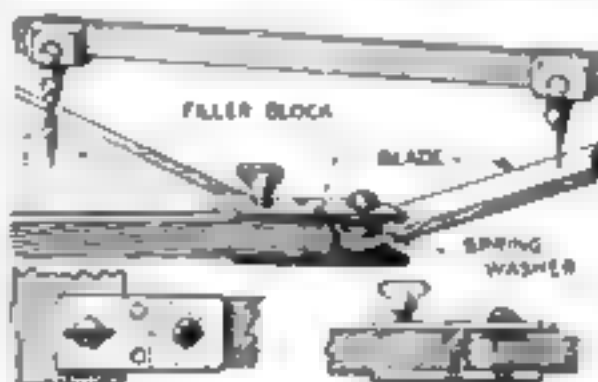
RADION
 Panels - Dials - Knobs - Switches - Insulators



Extension Arm Aids Draftsman in Drawing Large Work

ALL draftsmen who have used small drawingboards know how difficult it is to scribe radii, the centers of which are beyond the edges of the board. In such cases a detachable extension arm is a great aid.

The device illustrated consists of a clamping fixture and a soft wooden arm. Two pieces of steel with a spacer between are riveted together and a thumbscrew



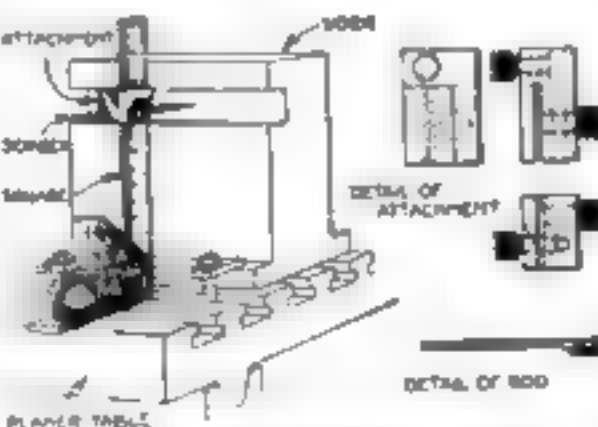
How the arm is used for scribing a large arc, and details of the clamp

is used to clamp the fixture to the drawingboard wherever needed. The arm itself is pivoted between the steel pieces by means of a screw and spring washer. The tension should be adjusted so that the arm will remain quite firmly wherever placed.—C. M. Wilcox

Direct-Setting Scriber Extends Range of Machinist's Square

BY MEANS of the simple attachment shown, an ordinary square is converted into a direct-setting scriber that will be found useful when scratching a center line on work that is strapped on a planer table and in many other places where the work is not easily accessible.

The drawing explains itself, but it should be noted that the beveled, cutaway setting edge is in the same plane as the scriber retaining hole. Thus, when the setting edge is brought to its predetermined position and clamped by the thumb-screws, the scriber point will be the same



Reading on scale shows actual height of scriber point above table

distance from the bottom of the square as the reading on the scale indicates.

By substituting a rod milled as shown in the detail in place of a scriber point, the device can be used as a direct-reading surface gage, wherever circumstances permit. In difficult locations, when the special rod cannot be used, the difficulty may be overcome through the agency of a common curved point, the contrivance then being used as surface gage.

Radio Bargains for THIS MONTH

Hedgehog Transformer	\$3.18
Reflex Crystal	.89
Battery Test Clips (each)	.08
100 Tube Adapter	.49
Licensed Neutrodyne Parts	19.95
Rheostats, 5, 3, 40 ohm	.20
Varicap diodes or Varicapeter	
30 degree each	1.25
Erie Reflex Transformer	4.85
Murdoch 1000 Ohm Phones	2.85
Jewell High Imp. Arrestor	.95
Cap. Two-way Plug	.49
Cockaday Cond. each	1.00
Con. act. Points or Switch	
Stops, per dozen	15
Special Prices on Tubes, Magnet Wire, etc.	

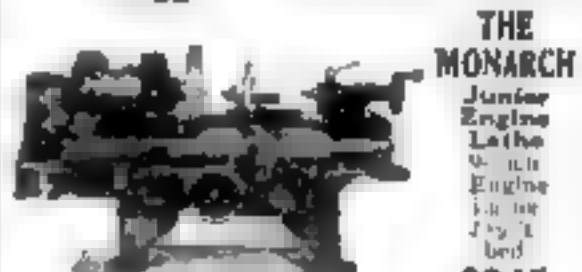
Clip this List - Check Items You Want - Enclose with Money Order

Your Order will be Filled by Return Mail - Package Free - Satisfaction or money back

FANS LIST OF FREE

RADIO BARGAINS
 17 N. LA SALLE ST.-CHICAGO

"The Biggest Little Lathe Built"



THE MONARCH
 Junior
 Engine
 Lathe
 4-1/2 in.
 Engine
 14 in.
 10 in.
 bed

\$245

Here is a sturdy, small engine lathe built with the same quality construction that has made MONARCH lathes standard for nearly over 40 years. It will do any small work any other lathe will do and do it with a 100% accuracy. It will fit in any shop or home work room. Easy to learn to operate.

Write for Free Catalogue of MONARCH Lathes which are built up to 30 inch swing.

THE MONARCH MACHINE TOOL CO.
 405 Oak Street Sidney, Ohio

How To Make Things Electrical

Have the fun of doing it yourself and save half the cost

This book gives directions for making hundreds of electrical appliances and devices for the home, the shop and the garage. The simple directions and many drawings make the work easy.

628 pp. Price, \$1.50 postpaid

POPULAR SCIENCE MONTHLY
 235 West 26th Street, New York City

ATTENTION GET THEM FROM COAST TO COAST

THE MIDWEST RADIO COMPANY
 2000 West 26th Street
 Chicago, Ill.

Radio Catalogue Free—

**Write us
a post card—**

Address Dept. 5-R

and we will send you free this 52 page catalogue of radio sets and parts. It also contains explanation of radio terms, map and list of broadcasting stations and much radio information, including an explanation of successful hook-ups and circuits.

You will be amazed at the low prices Ward's quote. A complete tube set having a range of 500 miles and more, including tubes, head set, batteries, and antenna equipment, as low as \$23.50.

This catalogue contains everything for the expert and amateur. Complete sets and every improved part for building sets, all the most up-to-date devices—at the lowest possible prices.

Headquarters for Radio

Montgomery Ward & Co. is headquarters for Radio, selling everything direct by mail without the usual "Radio-profits." Why pay higher prices? Ward quality is the best and the prices will often save you one-third. Everything sold under our Fifty Year Old Guarantee,—Your Money Back if You Are Not Satisfied. Write today for your copy of this complete 52-page Radio Book.

Write to our house nearest you. Address Dept. 5-R

Chicago Kansas City St. Paul Portland, Ore. Ft. Worth

Montgomery Ward & Co.

The Oldest Mail Order House is Today the Most Progressive



MAGNAVOX Products

EVERY condition in the art of radio reproduction is most successfully met by Magnavox apparatus.

Reproducers

R2 with 18 inch horn \$60.00

R3 with 14 inch horn \$35.00

M1 with 14 inch horn; for dry battery sets . \$35.00

Combination Sets

A1-R consists of Magnavox Reproducer with 14 inch horn and 2 stage Amplifier . . . \$59.00

A2-R same with 2 stage Amplifier . . . \$85.00

Power Amplifiers

A1-A One stage . . . \$27.50

AC-2-C-Two-stage . . . 55.00

AC-3-C-Three stage . . . 75.00

Radio users will be sent new 32-page Magnavox Radio Catalogue on request.



Magnavox brings you the Voice of All Christmastide

THE Art of Radio Reproduction is enjoyed by every Magnavox owner. Despite the ever-increasing quality and variety of Broadcast Programs, many a receiving set gathers dust unlamented because of insufficient sensitivity or an unsatisfactory "loudspeaker."

Every Magnavox owner is a master of the art of radio reproduction—the results obtained by the use of Magnavox Reproducers and Power Amplifiers cannot be equaled with apparatus constructed in the ordinary way.

The special attention of dry battery receiving set owners is called to the new Magnavox Reproducer M1, illustrated above.

Magnavox Products can be had of good dealers everywhere.

THE MAGNAVOX COMPANY
Oakland, Calif.

New York Office—370 Seventh Avenue
Perkins Electric Limited—Canadian Distributors
Toronto, Montreal, Winnipeg

MAGNAVOX PRODUCTS

There is a Magnavox for every receiving set



"Red Devil" Rapid Boring Auger Bits are 3 1/2", center boring, have 15° greater clearance, and bore with or against the grain of any wood. Style 2498 12 1/2 in. shown here, 75c.

Red Devil PLIERS

100 Styles—One
for Every Need



A PAIR of "Red Devil" Pliers multiplies by many times the number of useful things you can do about the house, shop, factory, garage. Hanging pictures, turning nuts and bolts, mending vacuum cleaners or sewing machines, amateur plumbing, etc.

Forged of steel, and distinctly superior in design. Just a few of the 100 styles shown here.

Slip Joint Plier No. 1024

(Shown at top.) For all around use. The thin nose gets into tight corners. Slip joint gives wide range to gripping jaw. Wire cutter and screw driver add to the number of things you can do with it. Sizes 5 and 6 1/2 inches. 5 1/2 inch size, \$1.00 a pair.

Side Cutting Plier No. 50

About as useful a tool as any mechanic can own. Powerful cutting edges. The standard electrician's plier the world over. Sizes 4 1/2, 5, 6, 7 1/2 inches. 6-inch size, \$1.10 a pair.

Combination Plier No. 999

For handling nuts, pipes, wire. Heavy enough for use as a hammer. Ideal for heavy work in general. Sizes 5 1/2 and 6 1/2 inches. 6 1/2-inch size, \$1.00 a pair.

"Red Devil" pliers are on sale at all dealers. Ask to see the complete line.

The "Red Devil" Mechanician's tool book is a handy reference guide for users of good tools. Send for it, it's free.

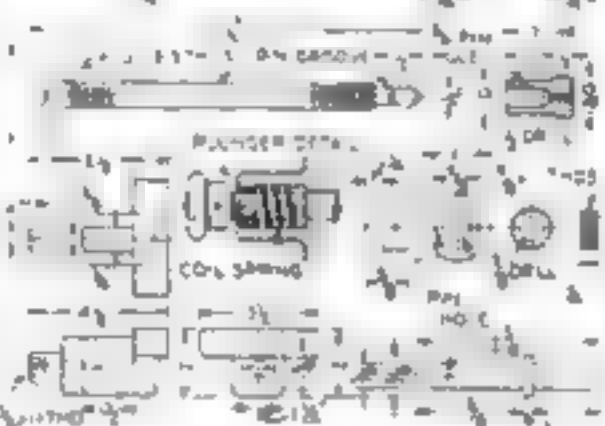
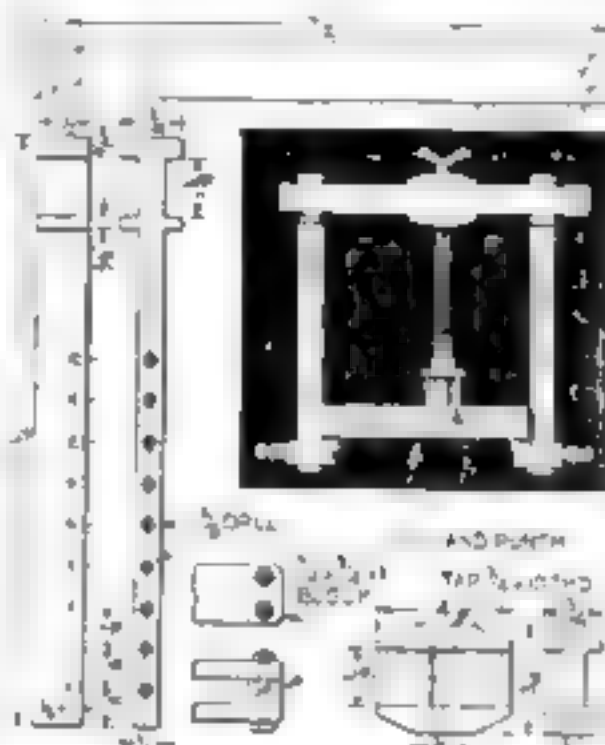
SMITH & HEMENWAY CO., Inc.
Manufacturers of "Red Devil" Tools
264 Broadway, New York, N. Y.

"Red Devil" Glass Cutters—
the glassers' standard tool of
the world. "It's all in the wheel."
Made in 48 styles.
No. 624 shown here,
30c.

How to Make an Improved Die Clamp

THIS die clamp, which will hold 12 by 12 in. pieces, is an improvement on the old "crab" clamp still widely in use.

With the crab clamp, the legs diverge whenever large pieces are inserted, and the leverage becomes correspondingly weak. With the clamp shown, the legs remain parallel, the base of the die rests firmly upon the legs, and a powerful direct pressure can be brought to bear



For large work this heavy clamp is superior to the ordinary "crab" clamp

upon the upper surface at any point across it.

The legs are loosely suspended from the cross piece so that the clamp can be adjusted for dies of any width up to the maximum.

If made half the size shown, the clamp would be a valuable addition to any machinist's toolkit for general work.

Expert Mechanics Tell How They Save Labor

"I've got some excellent shop ideas from your magazine," is a statement that appears in one form or another in many letters from our readers. That is because the best mechanics in the country write for POPULAR SCIENCE MONTHLY. If you are a mechanic, it will pay you to read the Better Shop Methods Department regularly. The January issue has articles by Larnby, Romig, Luer, Wheeler, Wilcox, Wicks and others, whose names are sufficient to guarantee the value of the material.

Morrison



Loud Speaker

Radio Satisfaction

True enjoyment of Radio begins when you and your family, at an extraordinary low cost, can hear and understand all the news, music, and entertainment that the air waves bring to you. Morrison Loud Speaker gives you this kind of Radio satisfaction and pleasure when attached to either type.

Phonograph or Horn

Attach the Morrison Loud Speaker to the one arm of your phonograph, place only a cushion, and you have the best of the two. Best phonograph sound, best of both in one form.

A 1/2" is drilled on the back of the Morrison Loud Speaker, and runs the full length of the speaker to all connected clear wires.

There is nothing to get out of order. Any one can use the Morrison Loud Speaker with the same perfect results as an expert.

Satisfaction guaranteed—your money back.

Price complete with 5 foot cord

Nickel Plated Model \$10.00

Gold Plated Model \$15.00

Order from your dealer or send direct to us if your dealer cannot supply you.

DEALERS

If you are interested in one of the fastest selling Radio sets in the world, write to us for our proposition. It is interesting.

Write for Illustrated Catalog

MORRISON LABORATORIES, Inc.
241 Jefferson Ave., East Detroit, Mich.

The Wireless Experimenter's Manual

E. E. Bucher

THIS book thoroughly covers the entire field of amateur radio work, including the theory and design of amateur wireless transmitters and receivers, the construction of transformers, high voltage condensers, spark gaps, aerials, masts, and receiving sets for long and short wave receptions. 330 pp. Fully illustrated. Price \$2.25.

Practical Amateur Wireless Stations

This book contains best suggestions of thirty-three experimenters on building, installing and operating experimental stations for radio communication.

Profusely illustrated 137 pp.

PRICE 75c

POPULAR SCIENCE MONTHLY
225 West 39th St. New York City, N. Y.

Hello Boys! **ERECTOR**

BUILDS LOTS OF TOYS

BOYS make wonderful models of bridges, cranes, derricks, wind-mills, skyscrapers, railroad signals, Ferris Wheels and machinery. Erector is not only the best fun in the world but it is splendid training.

This famous Construction Toy will delight any boy this Christmas

ERECTOR is the only actual structural steel toy. Every part is scientifically proportioned and correct in design. The boy who owns Erector or any other Gilbert Toy is made a member of Gilbert Engineering Institute for Boys, without cost. He can win valuable prizes, degrees and diplomas in this great Fraternity of American Boys.

THE A. C. GILBERT COMPANY
222 Blatchley Avenue, New Haven Conn.

Gilbert Erector is the only steel Construction Toy that builds square Girders



\$5

**Gilbert
Erector No. 4**

The most popular set in the world. It contains a story Electric motor to operate cranes, draw bridges and machinery.

THE A. C. GILBERT CO.
222 Blatchley Avenue, New Haven, Conn.

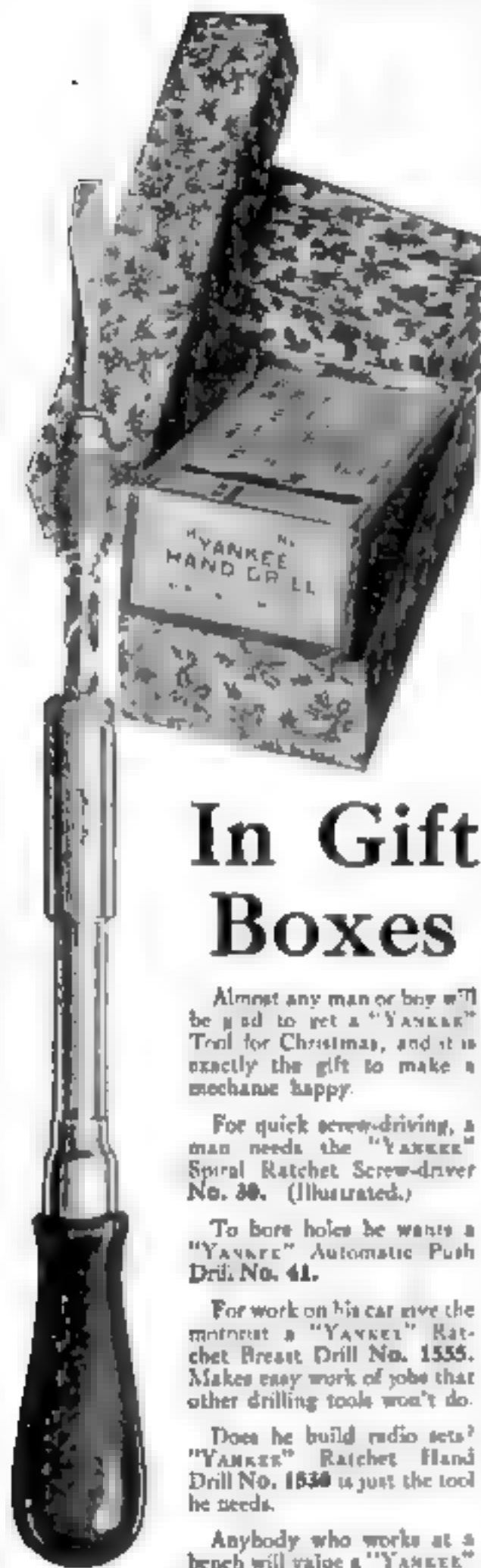
Send 10c to-day for Gilbert Year Book for 1924. Check full of interesting articles for boys: chemical experiments, athletic sports, tricks, useful facts any boy can make story of great engineering feats, etc., as well as a complete catalogue of the many Gilbert Toys. Enclosed find 10c. Send me Gilbert Year Book for 1924.

Name

Address

City

State



In Gift Boxes

Almost any man or boy will be glad to get a "YANKEE" Tool for Christmas, and it is exactly the gift to make a mechanic happy.

For quick screw-driving, a man needs the "YANKEE" Spiral Ratchet Screw-driver No. 30. (Illustrated.)

To bore holes he wants a "YANKEE" Automatic Push Drill No. 41.

For work on his car give the mechanic a "YANKEE" Ratchet Breast Drill No. 1535. Makes easy work of jobs that other drilling tools won't do.

Does he build radio sets? "YANKEE" Ratchet Hand Drill No. 1536 is just the tool he needs.

Anybody who works at a bench will value a "YANKEE" Vise No. 1992. Swivel base.

Then there is the "YANKEE" Tool Set No. 100—a full set of screw-driving tools, with attachments for drilling, etc. Solid oak case.

See the "YANKEE" Tools in Christmas Boxes, at your hardware dealer's. He will help you in your selection.

"Yankee" Tool Book sent free on request.

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

Making a Height Gage Base for a Vernier Caliper

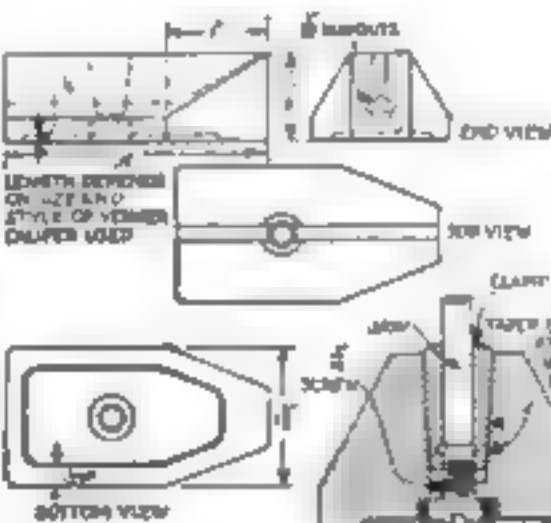
A SUBSTITUTE for a Vernier height gage, which is one of the more expensive small tools in the shop, can be made from a Vernier caliper. All that is

necessary is a firm base and a scratch blade.

The base is tool steel, hardened and ground. Its length should be proportioned to the

size of the caliper jaws to insure stability. The base is fixed to the stationary jaw of the caliper with a tapering clamp, as shown. The screw that draws down the clamp must be located exactly in the center of the base.

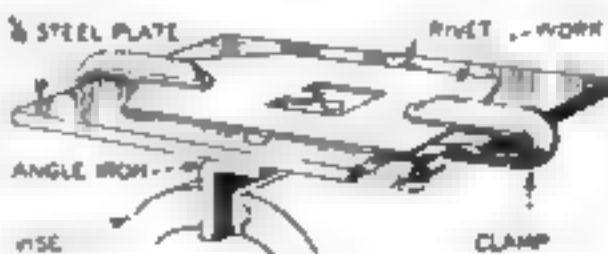
The scratch is clamped to the movable jaw with the point projecting well beyond the end of the base.



How the scratch point and base are made and attached to an ordinary Vernier caliper

Flat Face Vise Fixture Is Useful in Filing Thin Work

IN FILING thin parts of brass or steel, the vise fixture illustrated, which is used by a Washington, D. C., mechanic, is a distinct aid. It is simply a flat steel plate, with a vertical extension to be gripped in the vise jaws. Several deep-



The work is fastened with C clamps to a table held in the vise

throated C clamps are used for fastening the work to the face of the rest. The work is turned about as required to finish any part of the face either by shifting the clamps or turning the vise about, if the base is of the swivel type. A good size for the flat plate for average use is 8 by 10 in.

Pieces-per-Hour Tell You Straight

Are you getting ahead with the practical development of your machine?

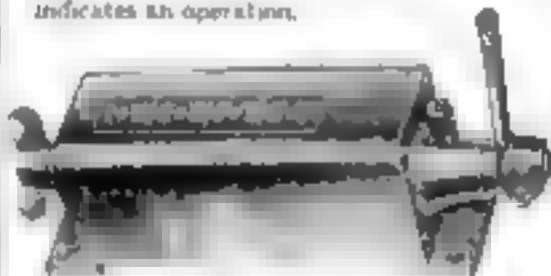
Are you getting larger production with each change in design or working adjustment?

Is the operator of the machine getting his methods down fine?

Your answer lies in the number of pieces per hour—recorded always reliably by a

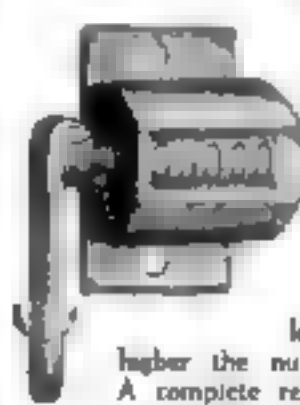
Veeder COUNTER

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a reciprocating movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, \$11.50—subject to discount. (Cut less than 1/4 size.) Set-back Revolution Counter of similar model, \$10.00 (net).

Thermal/Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording



the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the

higher the number registered. A complete revolution of the lever registers ten. The counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, \$2.00. Cut nearly full size.) Small Revolution Counter, also \$2.00.

Everything you could ask in a counting device is shown in the 20-page Veeder booklet. Ask for this free book.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

How three boys built a railroad

THREE boys sat disconsolately on the edge of the pond back of the old mill on the Jenkins' place. All week they had been building a railroad in the sand along the banks. They had leveled, and dug, and built up until they had the bed laid for a whole transportation system. There were grade crossings, and bridges and freight yards and even a tunnel. While along the edge of the pond Wally had built docks and ferry boat slips. But as Bob said, "What good is a railroad without any cars?"

"Why all the gloom, men?" said a pleasant voice behind them. The three boys looked up to see Mr. Jenkins, Bill's father.

Bill explained the lack of "rolling stock" for their railroad.

"Well!" said Mr. Jenkins, "Why don't you fellows chip in and get track and trains? In New York, I've seen some beauties that operated by electricity. They were exact duplicates of the big ones that run on the Central."

"Chip in?" asked Wally, showing empty pockets, "Chip in what?"

"My golly!" said Mr. Jenkins. "Anybody'd think you fellows were cripples. When I was a boy, if I wanted anything bad enough, I just went out and earned the money and got it. I know Bob there could make some money if he'd saw that big pile of wood I saw yesterday out in the back of his Dad's place. Wally can pick the apples down in the orchard and I'll find something for Bill to do. Get busy and see what you can earn. And then I'll tell you what I'll do! I'll give you a dollar for every dollar you earn. How's that, fair enough?"

"Oh boy!" Bob cried.

"Let's see that orchard," said Wally.

"Let's go!" shouted Bill, getting up in a hurry.

First meeting of the R. W. & W.

A MONTH later, the first meeting of the R. W. & W. Railroad (R—Robert, W—William, W—Walter) was held. Mr. Jenkins collected the money the boys had earned for the railroad.

Wally had seven dollars, Bill eight and Bob ten.

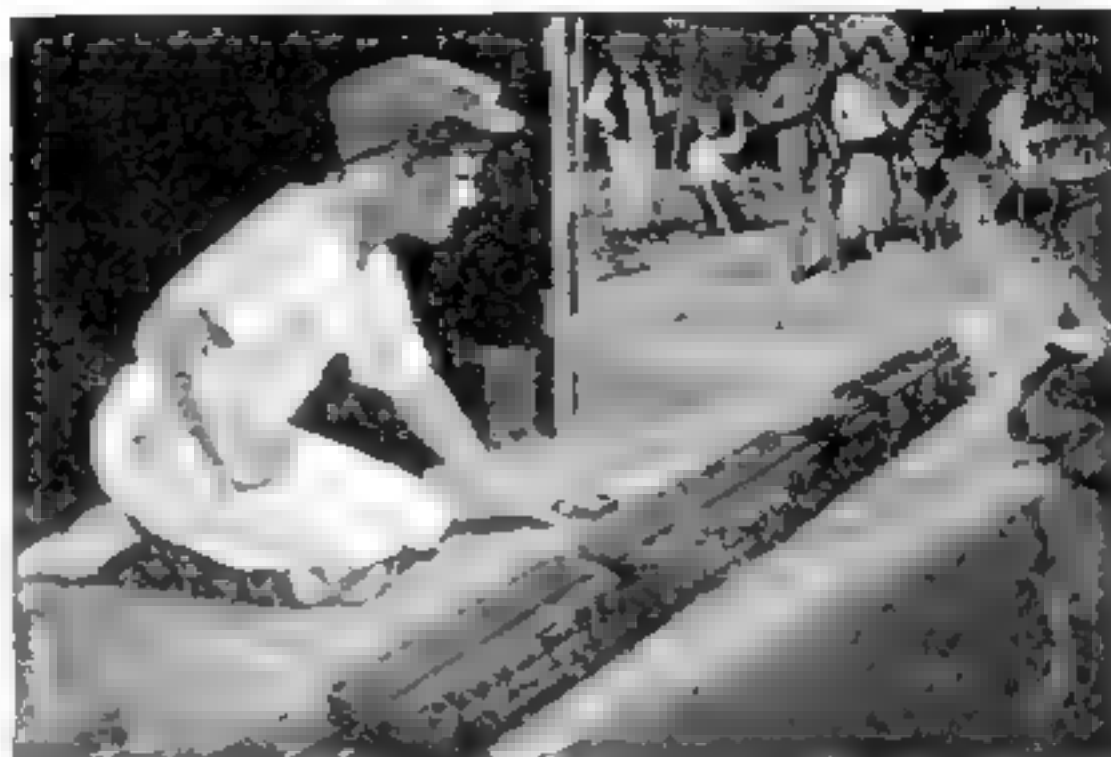
"That makes twenty-five dollars," announced Mr. Jenkins. "And now, as I said I would, I'll match your capital with the same amount." He took two new ten dollar bills and a five from his pocket and put them with the boys' money. "Total capital of the Railroad—fifty dollars."

"And now, gentlemen, if you three will meet me tomorrow morning early, we'll all go into New York on the eight o'clock and purchase 'rolling stock' for the railroad."

They buy "rolling stock"

WHAT A day those four had in the city!

On November 30th, at 2:30 P. M., Mr. H. C. Ives will give radio talk. "The Fun of Playing with Trains," Station W. E. A. F., wave length, 492 meters.



Mr. Jenkins took the three boys down to the Ives Display Room in the Fifth Avenue Building at Madison Square.

On great tables, which ran all around the big display room, were complete railroad systems. Powerful electric engines, perfect models of their big brothers on the Central, thundered along with mail coaches and Pullmans. A freight engine rumbled by, pulling a long line of flat cars, tank cars, and cattle cars, and in the rear a caboose. The boys looked on wide-eyed and noticed that each car was a perfect model of the real thing, even down to the monograms on the cars, which showed the cross of the Santa Fe, the seal of the N. Y. C. & H. R., the red and white circle of the Canadian Pacific.

There were semaphore signals, which showed red and green lights. Crossing signals that rang a warning bell as the Flyer approached. Trestle bridges, tunnels, freight and passenger stations, telegraph poles and street lights. In fact everything that you have ever seen in a big railroad.

There was a shriek from Wally.

"Oh boy! Look at these." He had found a big table on which were ocean liners, freight steamers, submarines, tug boats and racing yachts. "Gee! Couldn't we have some ships, too?"

"How about it, boys," suggested Mr. Jenkins, "couldn't we make Wally Captain of the Port and let him handle the ocean transportation?"

Everyone agreed to this and Wally, with the professional eye of a sea captain, picked out a liner, a tug boat for hauling freight, and a diving submarine for harbor defense.

The grand opening

A WEEK later, down behind the old mill, there was a scene of tense excite-

ment. Lined up on the bank were Mr. and Mrs. Jenkins, Molly—Bill's little sister, Ambrose—the colored man who cut their lawns, and Rags, the dog. Bob knelt on the ground beside a switch. Wally fussed with the mooring ropes of a liner which rode proudly beside her pier. Bill fastened an American flag to the halyards on a pole. All along the bank, ran the new railroad's tracks, gleaming in the sun. The semaphore signals showed "Clear track ahead."

"Ready!" cried Bob.

"Ready!" answered Wally and Bill.

Rags barked. Mr. Jenkins waved his hat and Mrs. Jenkins her parasol. Ambrose clapped. Molly shrieked.

Then Bob turned the switch and out of the door of the old mill rolled the Flyer, headlight gleaming, parlor cars lighted. Along the bank it flew, round curves, through tunnels, over bridges. Then came a long freight loaded with lumber and gravel for "overseas." Down to the water front it went and there stopped alongside a pier.

"How about the R. W. & W.?" shouted Bob.

"Yes!" hollered Bill and Wally and Mr. Jenkins and Ambrose.

Suddenly little Molly began to cry as though her heart would break.

"Why, dear, what's the matter?" asked Mrs. Jenkins.

"I wish I was a boy," sobbed Molly. And after all you couldn't blame her much—could you?

THE IVES MANUFACTURING CORP.
205 Holland Ave. Bridgeport, Conn.

I enclose 15c for which please send me your new smashing 32-page book that shows how to build an Ives Railroad. This book will also tell me about the Ives Fleet of boats.

Name
Address
City State



The hardest work needs

MOSSBERG

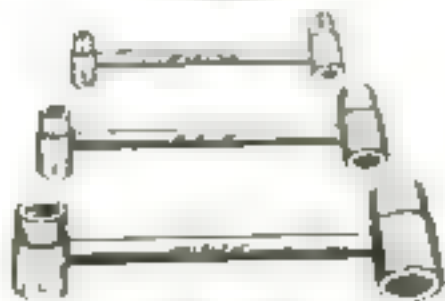
Chrome Manganese Steel

Wrenches & Tools

DON'T send a boy to do a man's work—or an inferior wrench to tackle a nut or bolt that's hard to handle. Make sure that if wrench or tool you use does the hardest job is a Mossberg.

Each Mossberg Wrench is made of chrome manganese steel and built for a particular job. The Mossberg idea is to have that wrench do the job a little better than any other. Hence the use of chrome manganese steel throughout the entire line—the one piece construction of the majority of Mossberg Wrenches—the exclusive

Ask your dealer for a Mossberg wrench and he will show you the difference. No other wrench can do the job as well as a Mossberg wrench. With a Mossberg wrench you can do the job right the first time. A Mossberg wrench is the only wrench that will do the job right the first time.



Four Way Socket Set

FRANK MOSSBERG CO.

Lamb Street, Attleboro, Mass.

The Home Workshop, Continued

How to Rebuild a Broken-Down Car

By Ray F. Kunt

Principal, Automobile Trade School
Cincinnati, Ohio

THE frame of the old car again is suspended from the springs. The wheels are again on the axles. The transmission system is installed again on its bearings, and the engine, separated into its component parts, is lying on the bench.

Before reassembling the motor, look carefully at each part. Allow no worn bearings, bent valve stems or other defective elements to escape your attention.

First of all, get a new set of gaskets to replace the old ones. Look at the oil lines and the oil pump to see that there are no obstructions. Then replace the valves, taking care that they are put into the block in the same order in which they were removed previous to grinding. The intake valves must fit the guide well in order that there will not be any leaking of air into the cylinders. The valve guides should be inspected and repaired, if they are found too loose.

Now for the pistons. If you have had to rehone any of the cylinders, make careful measurements of the new diameter. Piston rings about .005 in. oversize should be selected and at least the two top rings should be replaced, for heat and wear undoubtedly have reduced the tension of



Testing clearance with a feeler gage while fitting piston ring into place

the old rings. Be sure that all parts are covered with a film of oil before being replaced.

Broken or worn valve lifters should be replaced with new ones, as they might become a source of much trouble. If the valve has worn a hole in the top of the adjusting screw, reface the screw on a grinder so that measurements with an adjusting gage can be made.

An important point to remember is that the timing gears must be replaced in a definite position. If you have followed the directions previously given, you will have the gear marked. The flywheel markings will assist in checking the setting of the timing gears.

You will now have the engine complete and set in the frame. The next step will be the addition of the accessories.

Inspect the carburetor float for leaks by placing it in boiling water. A hole will be easily discernible. If there is some liquid within, punch two holes in the



Ready for the Road

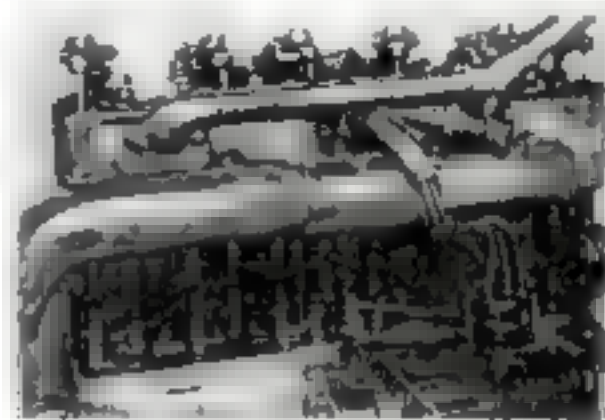
This is the last of three articles telling how Mr. Kunt rebuilt the 1918 roadster as shown above. It cost \$75 and the materials for repairing it, including paint, top, and tires, totaled \$35.

float, drain off the gasoline, and solder the holes shut. A cork float, if very old, may have become soggy. Test its floating qualities before putting it back in the carburetor.

The vacuum tank float must be examined in the same way. Scale will sometimes form at the bottom of the tank and dirt may lie loosely near the outlet. After cleaning the parts and seeing that the valves work easily, assemble the tank, being sure that the gasket is good and the tank airtight.

Wash out and clean thoroughly all gasoline lines and the main supply tank. Run a fine wire through all small nozzles and passages to remove any obstructions that might be there.

The gasoline system should then be clean from tank to cylinder. Put it together and start on the ignition system. Dismantle the generator and inspect the wiring and other visible parts. See that the brushes are in good condition and

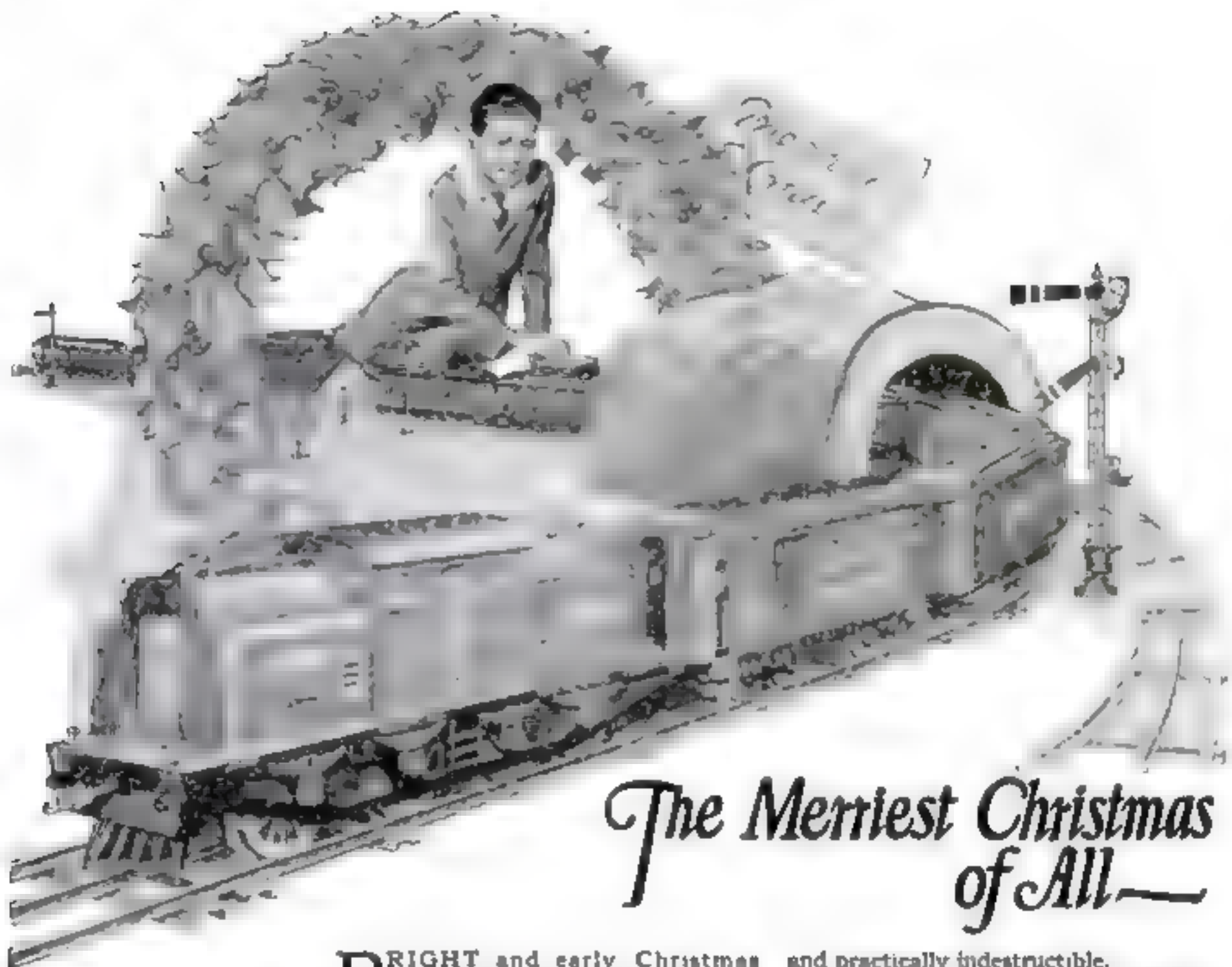


The engine partially reassembled after the worn parts have been replaced and the whole thoroughly overhauled

replace any that are not good. In making replacements, be sure that you sand them in to fit the surface. See that the insulation is not worn out at any point. A bit of tape added here and there will help.

It may be necessary to remove the commutator, turn it on a lathe, and cut the mica between the segments down 1/32 in. below the surface to prevent the brushes from riding on them. This can be done with a hacksaw blade. Then

(Turn to page 102)



The Merriest Christmas of All—



Lionel "Multivolt" Transformers

give unlimited power at very little cost. They are best for operating Lionel Trains. Safe - efficient - economical.

*Insist on Lionel
Accept No Substitute*

BRIGHT and early Christmas morning you and your boy will be running his Lionel Train, enjoying the thrills of the world's most fascinating and educational toy.

Lionel Trains and Miniature Railroad Equipment are exact reproductions of those used on America's leading railroad systems.

Lionel Locomotives are powerful enough to haul a train of twenty or more cars around curves, through tunnels, over bridges and across switches.

The realistic Lionel equipment includes Crossing Gates that automatically lower as the train approaches and raise as it passes by. Electric Block Signals flash "Danger" and "Clear Track Ahead," while Electric Warning Signals ring at the crossings.

All Lionel Locomotives, Cars and Accessories are of steel construction

and practically indestructible.

For 23 years Lionel Electric Trains have been electrically and mechanically perfect and fully guaranteed. They are attractively finished in rich enamels and baked like automobile bodies.

You can buy a Lionel Electric Train Outfit for as low as \$5.75. Or your boy can start his Lionel Railroad System with a larger locomotive and track and add to it. A Lionel Outfit is good for years and years of fun and happiness so there is real economy in buying it.

Lionel Trains can be operated from any light socket with a Lionel "Multivolt" Transformer—or from dry cells or storage batteries.

You can see Lionel Trains in operation at the best toy, hardware, electrical, sporting goods and department stores.

Send for the new 48-page Lionel catalogue—a handsome book showing the complete line in colors. It's free.



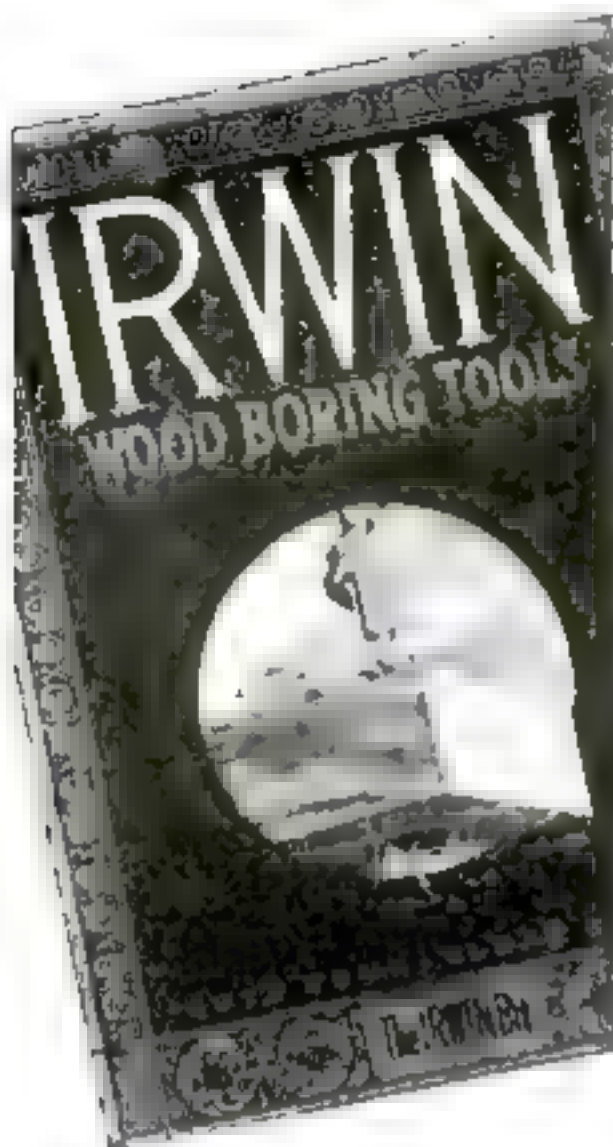
THE LIONEL CORPORATION

48-52 East 21st Street Dept. 15 New York City

"Standard of the World" Since 1900

LIONEL ELECTRIC TOY TRAINS

& Multivolt Transformers



**“the best book I’ve
ever read on wood
boring tools”**

"It contains the very information I've often wanted, but didn't know where to get. Your complete description of bits and augers and the simple explanation of how and why they "bore," have made plain to me the reasons for the birth of the Bor Family."

The above is only one of the many unusual comments received on our new catalog. In fact, it is more than a catalog—it is a practical working manual on the selection, use and care of bits and augers. If you haven't a copy, write today, giving name and address of your hardware dealer.

To Hardware Dealers: You, too, should have a copy of this book. If you haven't received it, send us your name today.

Address Dept. 112
The Irwin Auger Bit Co.,
Wilmington, Ohio

Originators and sole manufacturers
for more than 30 years of the famous
Jensen Hilt and Shaver

The IRWIN Bit
Reg. U.S. Pat. Office

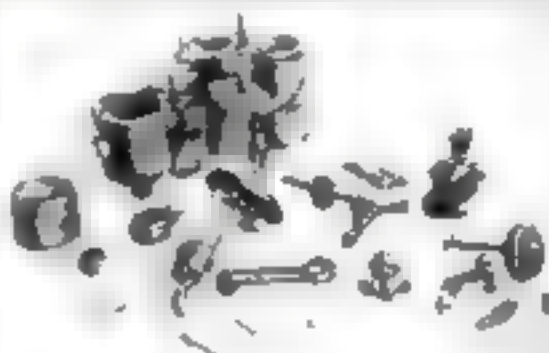
How to Rebuild an Old Car

(Continued from page 100)

see that all bearings are in good condition and put in a good supply of grease and oil before reassembling the generator

Test the generator with a battery to see whether it will run as a motor. If this works, it is reasonable to assume that it will work as a generator. When running on the engine, the third brush can be set and other regulations made so that an amperage of from 10 to 14 is obtained on a 6-volt system and from 5 to 7 on a 12-volt system. In the same way inspect and repair the starting motor, but do not undercut the commutator.

If the ignition is of the battery type, inspect the distributor, coils, and other parts, testing each carefully. New points



The subburst is taken apart, cleaned and inspected, ready for reassembly.

are frequently necessary on the distributor, but if they are only pitted, they may be honed or ground down to a new and true seat. It is well to renew all high and low tension wires, as the added expense is negligible as compared with the increased efficiency of the system.

If a magneto is in use as a source of ignition, it should be completely dismantled and all brushes and moving parts carefully checked. The points on the breaker mechanism of the magneto are platinum and very expensive. They are also softer than the tungsten used in battery distributors and are easily filed to a new seat.

Test the reassembled unit to see that it will generate properly. To do this, run a wire about the terminal screws on the distributor board and back to within $\frac{1}{8}$ in. of the frame of the magneto. When twirling the rotor by hand, a spark of sufficient intensity to jump the gap should be produced.

The engine timing gears

The water pump, as a rule, does not require much attention, excepting that

(Turn to page 103)

Coal too High? Science Says "Burn Free Air"

New Discoveries Make it Easy to Keep Homes Warm in Coldest Weather

No more paying exorbitant prices for coal. No more hauling and chopping wood. No more shivering in wintry weather waiting for fire to be built. Wonderful new device Nu-Heat takes one part of coal oil, or kerosene (the cheapest fuel known) and combines it with twenty parts of air (the only fuel for). Makes a cheaper gas than as you get. Gives intensely hot cheerful flame. A most instantly warm. The largest rooms on "blazingly" warm logs in a few minutes.

W.R. (the only price for) Makes a
 cheaper gas than any you can. Gives
 intense, yet hot, cheerful flame
 almost instant. Warm
 the largest rooms on
 "board" in a few
 minutes.

**A Warm House as Soon as
 You Arise-Cuts Housework 1/2**

AT TWIST
 OF WRIST-
 FIRE READY
 IN FEW SECONDS



ROOMS WARM IN 3 MINUTES

AGENTS

[illegible]

...the ...
...the ...
...the ...

Wade Hill Mfg. Co.
Dept. Z41 St. Louis, Mo.

Statement of the Partnership, Management, Circulation, etc., required by the Act of Congress of August 24, 1938, of Popular Science Monthly published monthly at New York N. Y. for January 1, 1939 State of New York, County of New York, do hereby make a solemn affidavit in and for the State and each of aforesaid, personally appearing before me, a Justice of the Peace duly sworn according to law, solemnly and sincerely that he is the Publisher-Manager of Popular Science Monthly and that he believes in, to the best of his knowledge and belief, a true statement of the ownership, management etc. of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1938, embodied in Section 443, Chapter 226 and Regulations, defined in the provision of this Act to be

1. That the names and addresses of the publishers, printing and publishing offices and business managers are: Publisher The Modern Publishing Company, Inc. 226 West Thirty-ninth Street, New York, N. Y.; Publisher, Reader 16, Salomon, 25 West Thirty-ninth Street, New York, N. Y.; Managing Editor, Reader 16, Salomon, 25 West Thirty-ninth Street, New York, N. Y.; Business Manager, U. S. 14, 24, 25 West Thirty-ninth Street, New York, N. Y.

2. That the owners are: The Popular Science Publishing Company, Inc. 226 West Thirty-ninth Street, New York, N. Y.; Stockholders of Popular Science Publishing Company, Inc. Henry A. Fisher, 22 William Street, New York, N. Y.; Oliver H. Capen, 226 West Thirty-ninth Street, New York, N. Y.; Robert L. de W. Wilcox, 463 Northfield Avenue, Marshall, N. J.; George H. Agnew, 21 William Street, New York, N. Y.; Susan U. Hill, 22 William Street, New York, N. Y.

3. That the known beneficiaries, legatees, and other security holders owning or holding in part or in name of the total amount of bonds, mortgages, or other securities are none.

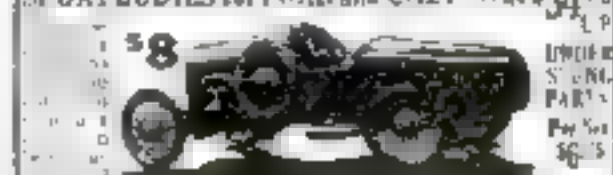
4. That the undersigned next above giving his history of the interests of stockholders and security holders, if any remain, but only the list of stockholders and security holders as they appear upon the books of the company last cited. In cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for which such trustee is acting, in case also that he paid to participants the full statements embracing plaintiff's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities to a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

Charles D. B. Carter, Business Manager

Warren to and subscribed below on this 15th day of
December 1933.

Paul M. Hone
(1944). Sir [Gunnar Jönsson](#) (1878-1924) March 31 1924

SPORT BODIES, INC. FORD and CHEV. 1981 at \$24.50



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 FREIGHT CHARGES
 HOW TO
 HOW TO
 CENTRAL AUTO SUPPLY CO. D-10, 132.

Making Toys for Christmas

(Continued from page 79)

finishing, as the enamel should be of a kind that can stand considerable rough handling and washing. If a first class enamel of the color desired cannot easily be obtained, get a good white or cream enamel, and tint it with artist's oil color in tubes, which can be obtained in any color.

The checkerboard should be laid out in pencil on the tray top or bottom, the latter being better if the table is to be used only occasionally for games. Make it 12 in. square and color the squares alternately red and black with a reusable oil paint.

The toy garage is a boy's toy. It can be used either as an independent plaything or regarded as an addition to a doll's house, if the children have one. It is intended as a companion piece to the doll's house described in the Home Workshop a year ago, and detailed in Home Workshop Blueprint No. 14.

Wood strips and wallboard are used in building the garage. It is 18 in. wide, 20 in. long, and 18 in. high. The sides are $12\frac{1}{2}$ by $19\frac{1}{2}$ in. wallboard, and the front and back 18 by 18 in. The corner posts are $1\frac{1}{2}$ by $1\frac{1}{2}$ by $12\frac{1}{2}$ in., there are 14 rafters $\frac{3}{4}$ by $\frac{3}{4}$ by $10\frac{3}{4}$ in. and a crown $\frac{3}{4}$ by $1\frac{1}{2}$ by 25 in. The front doors are two pieces of wallboard 8 by 10 in., and the side door is $8\frac{1}{4}$ by 6 in. Small strips of $\frac{1}{4}$ -in. stock form the trim for the garage and doors.

How to Finish the Garage

The garage should be neatly painted and the trim picked out in appropriate harmonizing or contrasting colors.

To furnish the garage with a toy auto, use one of the larger and better commercial toy cars or carve a body from soft wood and fit it with four wheels and a "spare."

The little wheelbarrow is a toy for the smaller children, very easy to make when the pattern for the sides is laid out. Painted up realistically, it makes a pretty toy. At the same time it has all the advantages of a regular wheelbarrow from the standpoint of the small boy, who likes nothing better than to cart his possessions around from place to place.

The sides are cut with a compass or keyhole saw (or a fret, band, or jig saw, if available) from pieces $\frac{1}{2}$ by 10 or 12 by $30\frac{1}{2}$ in. The bottom is $\frac{3}{4}$ by $9\frac{1}{2}$ by $12\frac{1}{2}$ in.; the headboard $\frac{3}{4}$ by $6\frac{1}{2}$ by $8\frac{1}{2}$ in.; and the tailboard $\frac{3}{4}$ by $2\frac{1}{2}$ by 12 in. The axle is $1\frac{1}{2}$ by $1\frac{1}{2}$ by $9\frac{1}{2}$ in. and should be of hard wood. The wheels are $\frac{3}{4}$ in. thick and 8 in. in diameter. Two iron rods about $5\frac{1}{16}$ in. in diameter and 10 in. long, with nuts, hold the head together, and one rod $14\frac{1}{4}$ in. long, the tail.

Full working details and complete lists of materials for all three toys are contained in POPULAR SCIENCE MONTHLY's Blueprint No. 29. This can be obtained from the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York, for 25 cents. A complete list of blueprints previously issued is printed on another page.



The size you want—the insulation you need

YOU don't need to wait while your panel is cut to order when you get ready to build your radio set. Just go to your dealer and ask for a Celoron Radio Panel. He will give you, without a moment's delay, the exact size you want. And—what is more important—ou get the proper insulation for successful results in radio receiving.

Celoron is recognized by radio experts as the best material for insulation purposes. Its high dielectric strength makes it the ideal panel material.

Used by leading manufacturers

Many of the leading manufacturers of radio equipment use Celoron in making their standard parts. It is approved by the U. S. Navy Department Bureau of Engineering and the U. S. Signal Corps.

Celoron Radio Panels come ready-cut in eight standard sizes, selected to meet the needs of the set builder. Each panel is neatly wrapped in glassine paper to protect the handsome surface.

Celoron panels are readily worked with ordinary tools at home. They are easy to machine, saw, drill, and tap.

Ask a radio dealer for one of the following standard sizes.

- | | |
|---------------------------|----------------------------|
| 1—6 x 7 x $\frac{1}{4}$ | 5—7 x 10 x $\frac{3}{16}$ |
| 2—7 x 9 x $\frac{1}{4}$ | 6—7 x 21 x $\frac{1}{16}$ |
| 3—7 x 12 x $\frac{1}{4}$ | 7—7 x 24 x $\frac{3}{16}$ |
| 4—7 x 14 x $\frac{3}{16}$ | 8—12 x 18 x $\frac{3}{16}$ |

We also furnish Celoron in full sized sheets and in tubes, and can cut panels in special sizes when desired. If your dealer hasn't yet stocked Celoron panels, ask him to order for you, or write direct to us, indicating by number the size you want.

Send for free booklet

"Tuning In On a New World" is the title of a booklet we have prepared especially for the radio fan. It contains a list of the leading broadcasting stations in the United States and Canada, an explanation of symbols used in radio diagrams, and several popular radio book lists. This booklet will be sent without charge, on request.

To radio dealers: Write for special dealer price list showing standard assortments

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CONDENSITE CELORON STANDARD RADIO PANEL

Deafness



Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relieved or Stopped Drums, Thickened Drums, Roaring and Hearing Sounds, Perforated, Whole or Partially Destroyed Drums, Discharge from Ears, etc.

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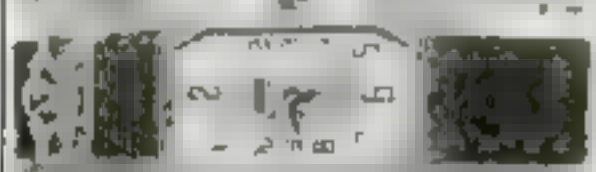
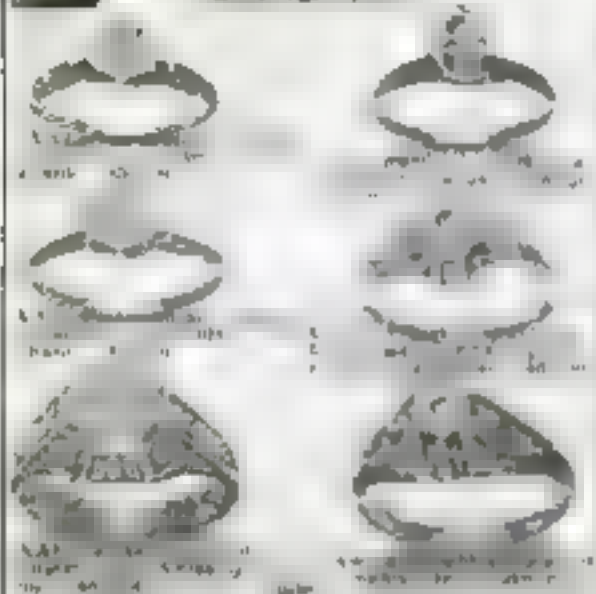
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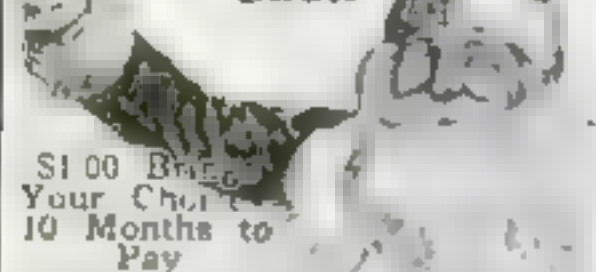
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Working Drawings for Useful and Novel Christmas Gifts

BESIDES a large variety of designs for useful Christmas gifts in this month's Home Workshop, you will find some unusually attractive pieces of furniture, toys, and other gifts listed below among POPULAR SCIENCE MONTHLY blueprints. Note particularly the Pullman play table (No. 28) and the toy train, horse, and house (No. 14); the kitchen cabinet work table (No. 27) and the kitchen cabinet (No. 5); the gateleg table (No. 24), the Colonial writing desk (No. 21), the sewing table (No. 1), the smoking cabinet (No. 2), and the two-stage radio receiving set (No. 6).

Having a good drawing or design to work by is half the battle. It will do more to insure success in your home workshop than any other single item. The tendency of many amateur mechanics is to start out to build something with little more than a general idea of the design in their mind or at best a very rough sketch. As a result, there is no efficiency or method in the construction, time is wasted in checking up details that should have been foreseen at the very beginning, and the builder's skill and patience are tried. All this can be avoided by having a fully detailed plan in the beginning and a list of materials.

For any project other than the most elementary, the home worker will find it is best to make a careful drawing and list of materials, or to make use of blueprints such as those in the Home Workshop series.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have checked below, for which I inclose.....cents in stamps or coin:

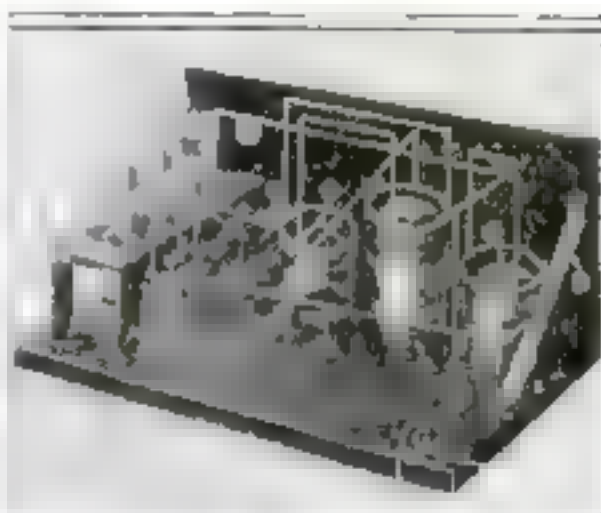
No.	Title	Price
1.	Sewing Table	25c
2.	Shaving Cabinet	25c
3.	Book Trough End Table	25c
4.	Kitchen Cabinet	25c
5.	V. T. Radio Receiving Set	25c
6.	Shaving Cabinet	25c
7.	Arbor with Gate and Seats	25c
8.	Porch Swing	25c
9.	Bench and Tilt Top Table	25c
10.	Electric Washing Machine	25c
11.	Ten Wagon	25c
12.	Toy Train Horse and House	25c
13.	Home Workshop Bench	25c
14.	Radio Cabinet	25c
15.	Chest and Mahogany Chest	25c
16.	Telephone Table and Stool	25c
17.	Grandfather's Clock	25c
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19.	Colonial Writing Desk	25c
20.	Girl's Cabinet and Desk	25c
21.	Pergola Garage	25c
22.	Gateleg Table	25c
23.	Sewing Outfit for Cabin	25c
24.	Baby's Crib and Play Pen	25c
25.	Kitchen Cabinet Work Table	25c
26.	Pullman Play Table	25c
27.	Toy Ten Cart Garage etc	25c

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John Davey needs young men

John Davey's organization, The Davey Tree Expert Co., Inc., has a large number of openings for young men between 20 and 30 years of age, single men preferred. The opportunity is unusual, offering good pay at the start, permanent employment in the Davey organization, and thorough scientific training in the profession of Tree Surgery. Advancement rapid, according to merit. The work is interesting, the experience gained extremely valuable. A demonstration will be held at the New York City Hotel, 100 Broadway, New York, on Monday, December 10th, 1934. Write or telephone immediately. The Davey Tree Expert Co., Inc., 33 City Bank Bldg., New York, N.Y.



Make Your Own RADIO Receiving Set

Use a blueprint of this two-stage regenerative receiving set with two stages of amplification, which, under favorable conditions, if a long high aerial is used, will receive 500 miles.

The blueprint is easy to understand and contains working drawings, instructions, and bill of materials.

Price 25 cents

Radio Map of the United States

With Dictionary of Broadcasting, Government and Commercial Stations, Call Letters, Wave Lengths, etc.

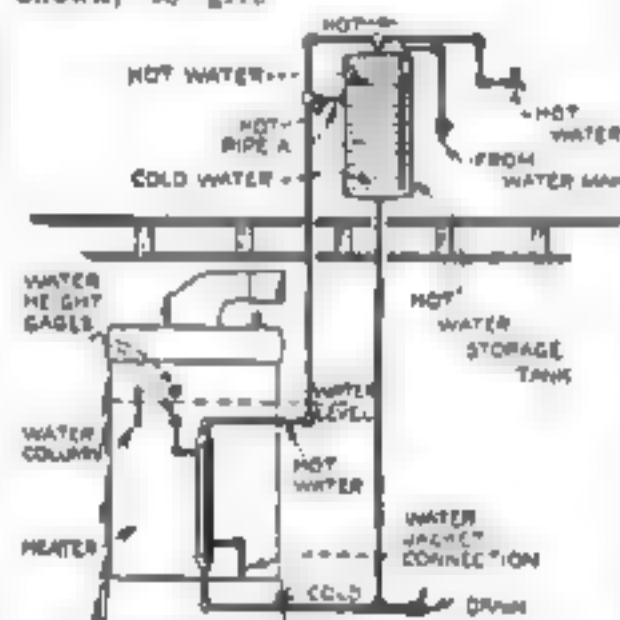
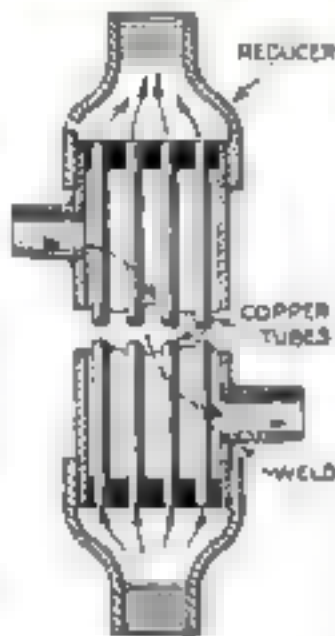
Price 35 cents

Popular Science Monthly
225 West 39th Street New York City

Using Steam from House Boiler to Heat Water

WHEN a steam-heating plant is used to heat water for the house water system, the usual practice is to place a coil of pipes at one side in the combustion chamber. This is objectionable because in small firepots one side of the water jacket is made less efficient and the coil itself is often in the way when the fire is being stoked. The heating device illustrated was made to avoid these difficulties, and it gives a very quick and hot flow of water.

It is made from ordinary pipe, pipe fittings, and copper tubes. The ends of the large pipe are closed and sufficient tubes are placed in it, as shown, to give



Heating device (above) and general arrangement of the water heating plant (below)

the same area as the area of the outlet pipe. The space around these tubes is connected with the water jacket of the boiler by a short pipe, as indicated. Therefore water at very nearly steam temperature constantly surrounds the copper tubes. Cold water enters the tubes from the bottom and in passing up through them becomes hot.

This heater is connected in the usual way with the storage tank, except that the pipe leading into the tank just above the center is an improvement over the regular method.—PAUL H. BYER.

Capping Tool Handles

A WOODEN tool handle can be fitted easily with a leather cap. Cut off the top squarely to form an even bearing for the leather and then cut a piece of sole leather to suit. Glue this to the top of the handle and fasten with half a dozen shoemaker's tacks. The end of the wood can't come through a handle of this sort, and if carefully made, it will last for years.—B. Y.



An Appreciated Gift

Charges Radio and Auto Batteries at Home Over Night - For a Nickel!

For a friend who owns a radio set or automobile, what could be more appropriate than a gift which would eliminate the inconvenience and expense of taking his battery to a service station every time it requires recharging? The

GOLD SEAL
HOMCHARGER
The World's Most Popular
Battery Charger

is such a gift, appropriately dressed up in a beautiful Christmas package, too. It charges any AUTO, RADIO or "B" storage battery in the simplest, quickest and most efficient manner possible. Connects to any lamp socket—operates silently—requires no watching. Fully automatic in operation—absolutely safe.

HOMCHARGER'S TEN POINTS OF SUPERIORITY

1. **Simple**—Only one moving and wearing part replaceable after thousands of hours use for \$1.00. Will last a lifetime.
2. **Efficient**—Uses less than one-half the current of any other equal size recharger. Will charge any radio or automobile battery for a nickel.
2. **Quick**—In high charging rate of 7 amperes eliminates long waiting. A hot dry tube and charge! Will charge any "A" or "B" battery in one night, or three times as fast as a 2-ampere machine.
4. **Clean**—No expensive bulbs to break or acids to spill or replace. No acid fumes. Charges without mess, heat or bother.
5. **Dependable**—Tungsten contacts insure continuous operation—prevents sticking and stoppage.
6. **Fool-Proof**—Can be operated by anyone. Attach to lamp socket and connect battery either way. It will always charge. High-grade ammeter eliminates guess work.
7. **Safe**—No danger of shock or fire. Tested and approved by Fire Insurance Underwriters everywhere. Gives tapering charge—without overheat or thru battery.
8. **Beautiful**—Mahogany and Gold Finish.
9. **Unqualifiedly Guaranteed.**
10. **Popularly Priced**—Retail at \$18.50 complete \$15.00 (Canada). No extra to buy. Sold by all dealers.

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ACCEPT NO SUBSTITUTE. Like all good products, the HOMCHARGER has been widely imitated. No other charger is just as good. INSIST on seeing our registered trade mark, the "GOLD SEAL," on nameplate and carton before purchasing.



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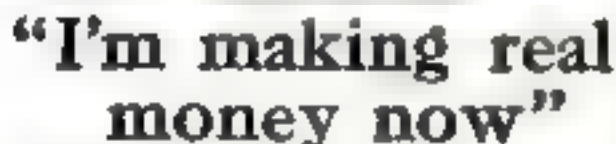
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A word is in the plural if you can't "Without rest,
without changing," not make any more this compound.

Fig. 7M4-4 Section, Penn.

Without any obligation on my part, please tell me how I can assist you in the subject before which I have no doubt.

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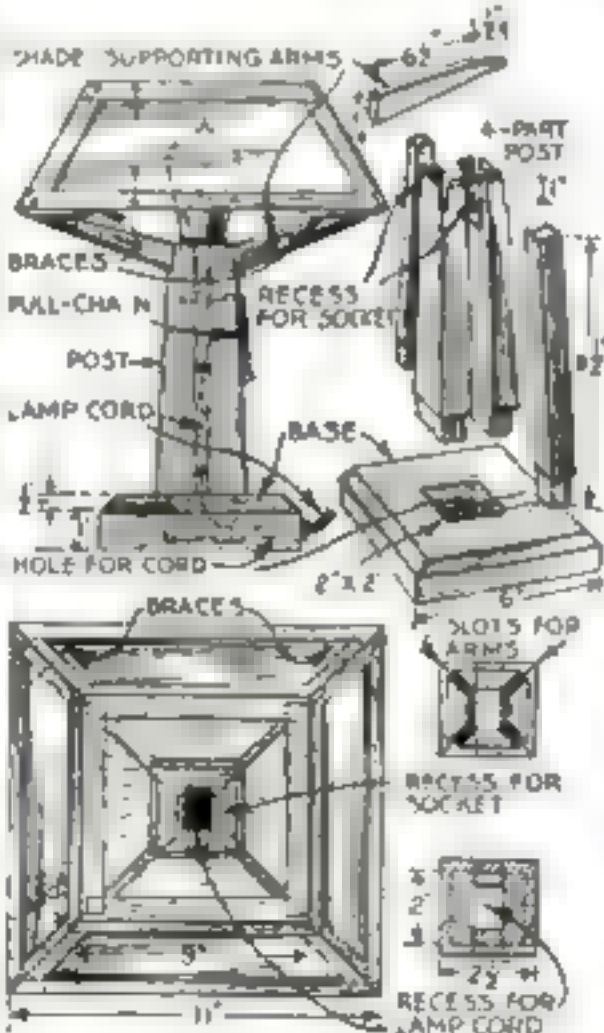
POPULAR MEMORIE MONTHLY
 215 West 20th Street New York City

By James Ellis

The lamp is of mahogany and red art glass.

the column and a hole for the lamp cord.

The column is made of four pieces glued together, mainly so that the recess for the socket can be worked out with less trouble, but it can be shaped from a solid glued-up piece. A regular pull socket is used, but the brass outer shell is discarded and the fiber cover is glued in the socket recess when the column is assembled. A hole for the chain is bored through one of the sides. The wiring is carried through a



Side and top views of the lamp and details of the base, pedestal, and arm.

central hole to the base before the column is glued together

At the top of the column four slots are sawed, one at each corner, to take the arms that support the shade. These arms are made tapered and are set into the column at a slight angle.

Continued on page 111

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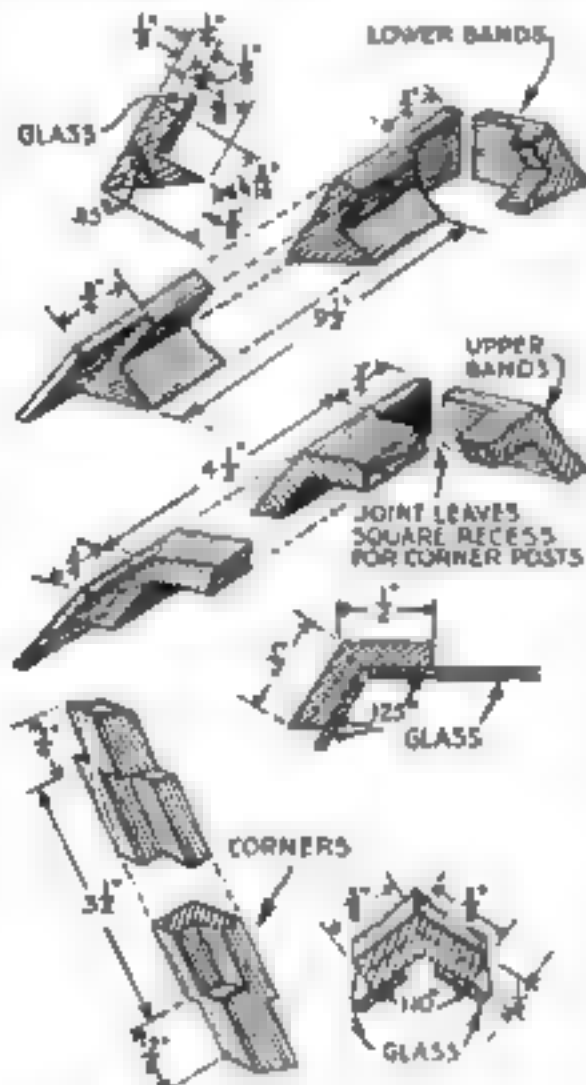
Popular Science Monthly
229 West 11th Street New York

Craftsman's Table Lamp

(Continued from page 110)

Although it seems rather formidable, the shade is really not difficult to make. If a protractor or bevel is not among the tools available, the frame should first be laid out full size on paper. The main angles are cut at 60 degrees and the joints are made in the fashion of a half lap, the tongues being $\frac{1}{2}$ in. thick. The cutting is done on the inside, where the glass goes. The outer angles can be planed, but the inside will have to be finished with a chisel.

The shade frame is assembled by gluing together two panels and letting them dry before putting on the connecting pieces.



How the pieces for the shade frame are cut out and put together

If the lengths have been laid off accurately, and the angles cut carefully, they should go together without any trouble. They should be clamped and left overnight for the glue to harden.

Since all of the bands are made the same length, it is necessary to trim off the ends of the bands glued first, so that the remaining bands will go on properly. A file is a most useful tool for the delicate fitting and lapping, as the depth of the laps is only $\frac{1}{2}$ in.

A place on the bench is cleared off for the final assembly, so that the corners can be tried with a square and thoroughly checked for trueness before the joints are clamped or tied together.

At each corner of the shade a small piece of wood is glued to take a small wood screw passing up through the end of each arm.

The lamp should be stained and finished as desired before the glass is set. The glass is bought cut to the exact sizes and is put inside the shade with small nails, wood screws, glazier's points, putty, or sealing wax.

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Old Electric Lamp Makes Novel "Crystal" Gazing Globe

CRYSTAL gazing globes, sometimes used by seers and mind readers, cost from \$5 for the cheapest glass to \$500 for the larger, highly polished crystal ones. An excellent substitute, which can be made in the home workshop almost without cost, will give just as much amusement as an expensive globe and can be easily "doctored" to provide mysterious "visions."

The writer made the "crystal" illustrated from an old, sphere-shaped, tipless electric light globe. The copper shell at the end was removed and a tiny hole was filed into that part of the globe formerly covered by the metal. Air was admitted gradually so as to avoid breaking the bulb. A ring was then filed around the socket part, next to the globe, and the sphere shaped part broken off by gently tapping it. Fitted and glued to a turned wood base, the sphere forms an excellent gazing globe.

The diagram shows how a special base was constructed to give entertainment to friends. It was made of a 4-in. length of cardboard mailing tube, covered with black velvet and glued to the wooden base and to the globe. Inside the tube is a small flashlight battery which supplies current to a light when a button switch, concealed under the velvet, is pushed.

The light illumines a transparent picture and causes it to appear in the



The "crystal" globe



globe, as if a materialization in a stance. The opening beneath the globe for the reflection should be small and hidden as much as possible by the velvet.

A picture to suit the "medium's" purpose is drawn on glass or celluloid or a transparent slide, as for a magic lantern, or is made from a photograph.

Before putting a paint brush away wash it thoroughly with kerosene, and while still soaked, wrap it in waxed paper. Use turpentine, gasoline or benzene to wash it out before using it again.

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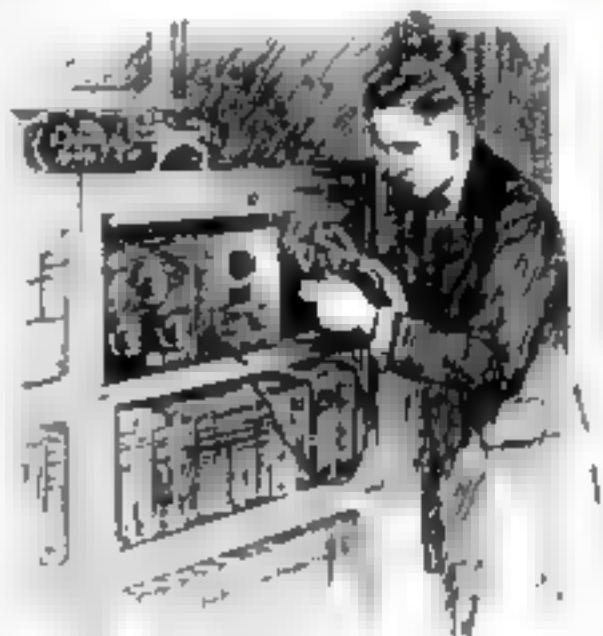
Don't Miss This

PARAMOUNT MFG. COMPANY

Box 1378, Ruston, Mass. U. S. A.

Radio Receiving Set Fits Well in Sectional Bookcase

ONE radio fan solved the problem of providing a neat and convenient cabinet for his radio receiving set by putting it in one compartment of his sectional bookcase. A 1-in. thick wooden baseboard was stained ebony black, and the composition panel was attached to the base with short brass screws. The set was shallow enough so that, when placed on



A convenient place for the radio set. The loud speaker, if used, can be placed on top of the bookcase.

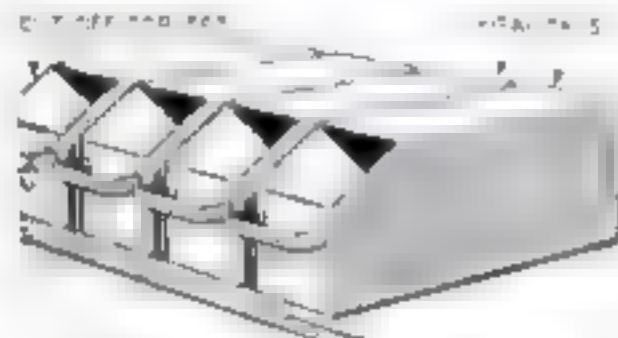
the bookshelf, the sliding door of the compartment could be shut.

Being placed in the third tier, the set is just the right height for comfortable operation. The cavity to the right of the panel is utilized as a storage place for the head phones, and a hook screwed to the end of the bookcase supports wires that run to the batteries. The batteries are placed in a neat box, stained and varnished to match the bookcase.

When adjustments are necessary, the set is pulled out bodily and placed on a table.—J. R.

Cheaply Made Bins for Nails, Screws, and Hardware

MANY home workshops and garages have not a sufficient number of bins or drawers for small parts, such as bolts and nuts. An economical way of



Empty oilcans with a corner cut off make handy containers in the home workshop.

making containers for this purpose is to cut a corner off empty one-gallon cans, as illustrated. This is easily done with a can opener and tin snips.

The handle is used as a pull for the bin and also provides a place where a label can be glued. Shelves may be arranged to hold any number of cans.—J. E.



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Camping Out at Home with a Fireplace Cooker

TO THOSE who have an innate desire for campfire cooking, I suggest an occasional meal prepared on a tripod over the flames in the fireplace. Try this for a picnic Sunday supper or for that luxurious night when the maid is away.



The Iron Tripod

The tripod is necessary because modern fireplaces, although quite common, rarely have cranes. It is simply a triangle of iron with 7- or 8-in. sides mounted on legs that have a slight outward

spread for steadiness. The legs may be 4, 5, 6, or more inches high. You can have the stand made by your local blacksmith.

This tripod, which can be placed right over your fire, supports three pans, one on each corner. With a lively blaze to cheer you, you can cook whatever you wish and broil steak over the coals beside — A.D.P., Hindman, Ky.

Shed-Roof Brooder House Serves Double Purpose

POULTRY raisers who are planning to build new chicken houses will find a useful suggestion in the accompanying illustration of an up-to-date shed-roof brooder house. It was recently designed and built by the Poultry Husbandry Division of the Bureau of Animal Industry.



The outside of the poultry house (above) and the interior with brooder stove (below).

United States Department of Agriculture, for experimental use at the Government poultry farm, Beltsville, Md.

The house is 10 ft. wide in front and 14 ft. deep. It can be used for laying hens as well as for brooding purposes, so is especially valuable on farms where chicken raising is more or less of a side issue.

When used as a brooder, the chickens are kept near the stove for the first two days of their life. — S. R. WINTERA.

Simply Made Concrete Strongbox Safeguards Valuables

By George A. Luers

THE advantage of having a fireproof and, if possible, secret container in the home for deeds, notes, valuable papers, jewelry, and silver plate, can hardly be overestimated. Any one who has been through a fire or suffered a burglary knows the dollars-and-cents value of a good strongbox. The small deposit boxes available at banking places are best of all, of course, but relatively few householders find it convenient to use them for everyday purposes.

To make up a serviceable small safe deposit box of concrete is not difficult and it will be fireproof and, if well concealed,



Cut-away view of the completed strongbox and the wooden forms

practically burglar-proof. A basement wall location is usually best. If the box is built into a wall it cannot very well be removed from the building, and if it is concealed with a screen or shelving, it is not likely to be discovered by any outsider.

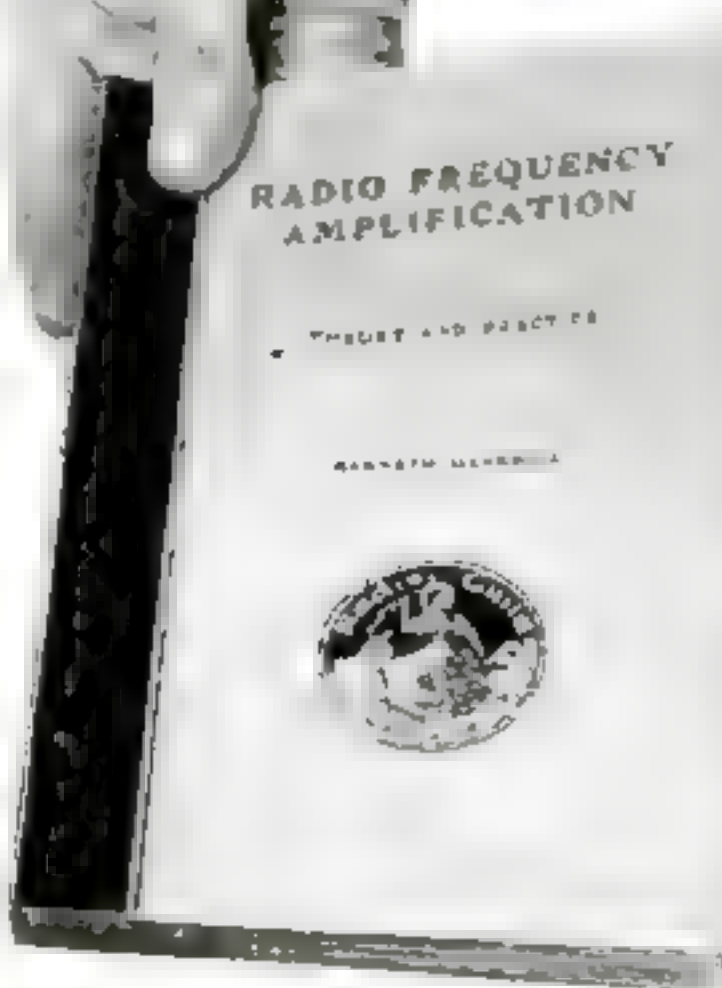
A 2-ft. square excavation, about 3 ft. deep, is made into one of the walls at the desired location. A box form is constructed of wood to form the mold for the interior of the box; this is about 15 in. square and 30 in. deep. The cavity itself serves as the outer mold.

The concrete mixture should be quite rich in cement, the proportions being about one part cement to two parts sand. In pouring the box, the forward top section of the form is left off; the concrete is then poured in and tamped, and the final filling is made at a small aperture above the edge of the top of the form after the top piece is put on.

To do this properly requires some care and the mixture must be quite liquid, in order to prevent any "voids" being left in the concrete. In many cases it is easier to dig down through the earth from outside, if the distance is not great, and fill the back part of the form from above. In fact, various expedients can be adopted in pouring forms of this type. Meshed wire is used about the front of the box to

(Turn to page 116)

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In the first part of his book the author leads you step by step from the elementary laws of electricity to the advanced principles of radio reception. His arguments are so skillfully worded, his explanations are so simple and understandable that you will quickly and easily learn how modern radio receivers operate.

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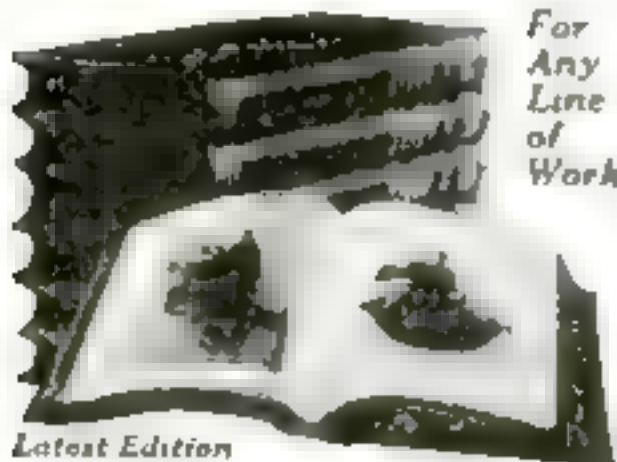
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Simply Made Concrete Strongbox

(Continued from page 115)

prevent the concrete from cracking and breaking out.

A wooden form is made for the door, as indicated, and meshed wire is used as reinforcement. The hinges and hasp are set in place as the concrete is poured, so that they are cast integrally. These parts are wrought-iron fixtures of heavy construction, such as are used for barn doors.

The pin parts of the hinges, which enter a wall section, are wrapped with wire and the ends are left protruding into the form, so as to make a solid bond into the concrete.

After the concrete has hardened or set for a period of two weeks, the interior and door should be finished with paint. Linseed oil is used for the first coat, followed by one or more coats of any good paint and a final coat of white enamel.

A good strong padlock serves as the lock. If the casing and door have been made carefully, with the concrete thoroughly mixed and reinforced with wire, and the hinges and hasp set to match up evenly, the box will prove a tight, safe, and commodious receptacle for the small valuables that are not infrequently a total loss through fire or burglary.

Leather Flap Protects Padlock from Snow and Ice



ALTHOUGH the better grades of padlocks are designed to withstand exposure and abuse, they will last longer and be easier to handle if protected with leather or rubber flaps, as shown. Even in the most severe weather, these protectors prevent the padlocks and hasps from becoming frozen and caked with ice and snow.—F. J. A.

To Clean Household Brushes

BRISTLE brushes should be washed with lukewarm water and a little ammonia, although borax or soda can be used in place of ammonia. Cleanse the bristle part thoroughly, shake out, and let the brush dry in the sunshine.

Dipping the bristles in a strong solution of alum will make them stiffer.—R. C.

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Building a Realistic Toy Theater

(Continued from page 122)

designs from magazines, and a few colored papers together to make some kind of an ornamental arrangement around this frame, leaving a clear stage opening 8 in. wide and 7 in. high, which is later cut out. It is well to use two pieces of cardboard for the arch, joining them together with a strip of calico pasted on the back.



The proscenium is made from cardboard and covered with wallpaper and painted outside.

This will permit folding so that the proscenium can be packed away in the box when the stage is to be put away.

The front of the box is concealed by another cardboard strip 5 in. high and about 20 in. long. This is also in two parts so that it will fit into the box.

The curtain is just back of the prosecution and consists of a piece of cloth with a picture pasted on it. It is weighted on the bottom with one or two pieces of iron wire. Near one end a cord is firmly fastened for raising or lowering the curtain, the cord winding around the roller. The roller is held in place like any window-curtain shade.

The side scenes and backgrounds can now be made. Each background must have two side scenes to match, cut from cardboard about 11 in. long and 9 in. high. The opening in each side scene may be the same as the stage opening, that is, 7 by 8 in., although it is better to make it about 1 in. larger each way.

The backgrounds also are 9 by 11 in. They may



The complete stage, showing the sliding background and side scenes.

the last groove of the stage and of the upper bars; the side scenes fit the other grooves, so that all can be pushed in and pulled out easily.

When a number of scenes have been prepared, a few figures can be mounted on cardboard and cut out. Placed on the stage in small wire brackets, small plays

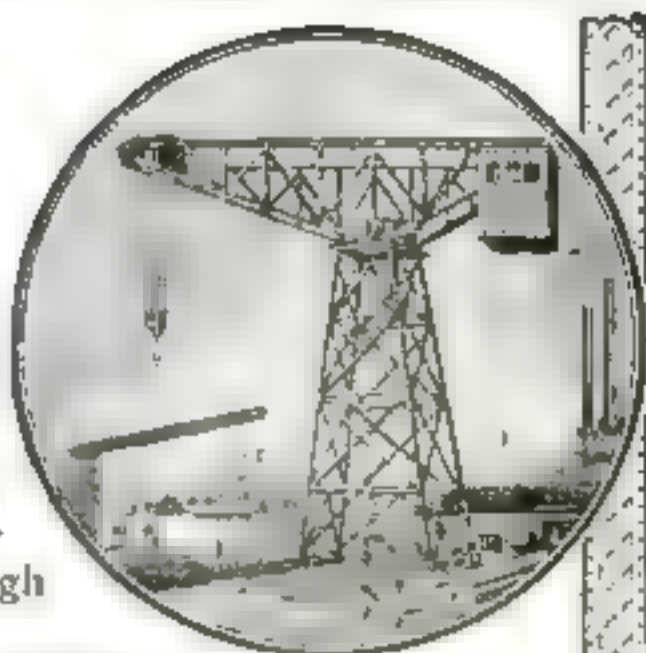
{ Turn to page 124

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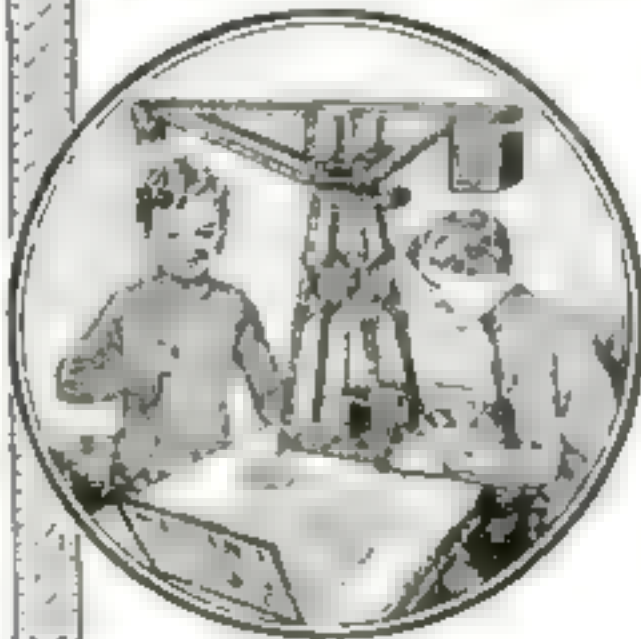
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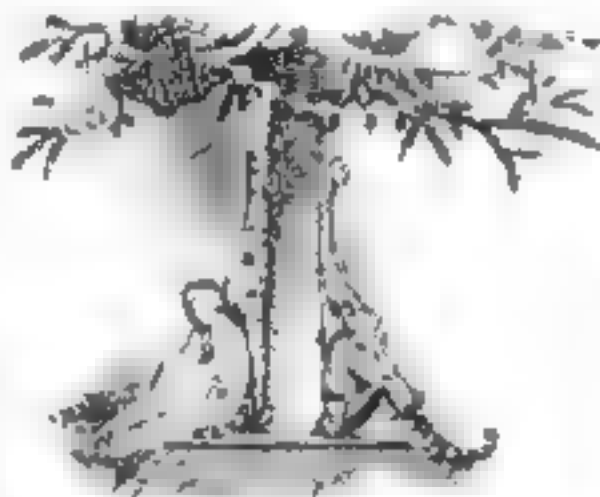
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Fairy Figures Form Novel Christmas-Tree Stand

CHRISTMAS trees in Europe, where so many of our Yuletide customs originated, are usually gathered and sold with the roots attached. They are then set up in a large pot or tub, according to size. This has advantages, from a picturesque standpoint, over the American practice of mounting Christmas trees on a stand of two crossed sticks.

More novel than either method is to have some pixies or fairies holding the tree upright. Three or four of these, as shown in the accompanying illustration, can be cut from thin wood (three-ply paneling is best) with a fretsaw or a sharp



knife and painted as decoratively as possible. These figures do not require a solid base; a diagonal brace between them will be ample. Flat pieces may be nailed to their backs, if desired, to make it easier to attach them to the tree trunk.

Another method is to make the figures like big dolls, but with stiff wire along the legs and up the backs, passing out through the shoulders and round the stem of the tree, with perhaps a sash right around them all for a lower support.

Make the figures large enough to form a steady support, say 18 in. high for a 6-ft. tree.—E. A. M.

FEATURES FOR JANUARY

NO MATTER what particular aspect of the home workshop interests you most, you will find exceptionally useful articles relating to it in next month's **POPULAR SCIENCE MONTHLY**

First there are the prize-winning letters in the recent tool contest.

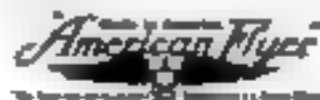
Then, for the woodworker, there are articles on how to build an ideal home workshop wall cabinet for tools and a combination bench hook, miter block and shooting board; on weatherstripping your home, and on rebuilding a pedestal dining table.

Those interested in outdoor sports will find unusually good plans for a non-tipping bobbed and a racing skate sail.

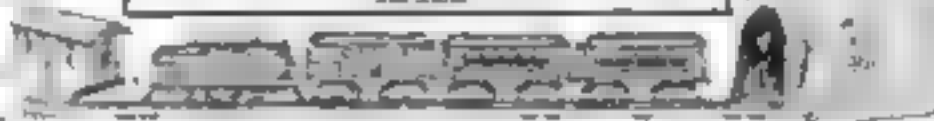
For the children, there is a child's kitchen cabinet, for the typist, a cheap method for making rubber keys. Similarly, for the autist, the radio fan, and the metal worker, there is a great wealth of helpful material.

"American Flyer" Railroads
and "Structo" Automobiles

Here's great news, boys and girls—this year we have made more "American Flyers" than ever before, so every Toy Store in your town can get a supply. We are also selling "Structo Autos"—you can buy them "Ready Built" or you can get them "Knocke' Down" and put the parts together yourself. Remember, The American Flyer Company GUARANTEES all trains to be electrically and mechanically perfect. If any Toy Store hasn't got the "American Flyer" or "Structo" outfit that you want we will ship any of the trains, autos or equipment illustrated, post-paid on receipt of cash.



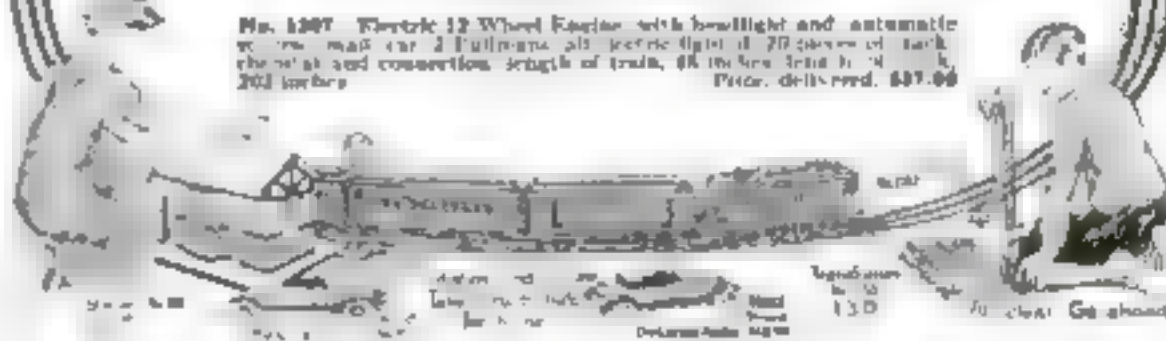
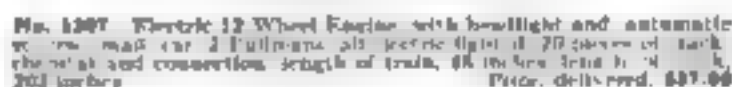
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To Make a Pair of Skis

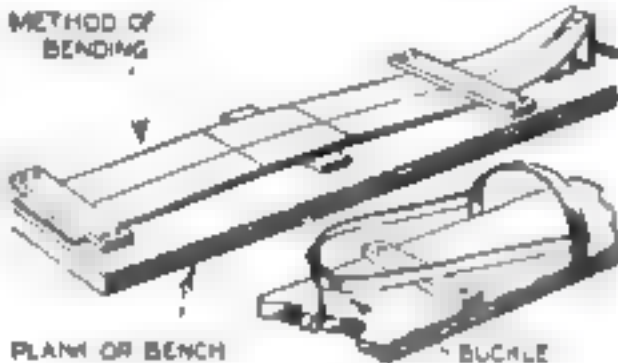
(Continued from page 132)

full width, to avoid splitting while drying. Allowance should be made for the springing back of the wood when removed from the form, say 1 in. extra for the long curve of the body and 1½ in. for the point.

Allow plenty of time for drying; a week is not too much, and damp weather will retard the drying. When dry, give all but the bottom two coats of spar varnish and rub the bottom with hot beeswax, polishing it well with a rag.

There are several types of foot harness, and any kind that strikes the fancy may be copied. The one shown, however,

METHOD OF BENDING



PLAN OF BENCH

The form for bending the ski and one simple design for the foot harness

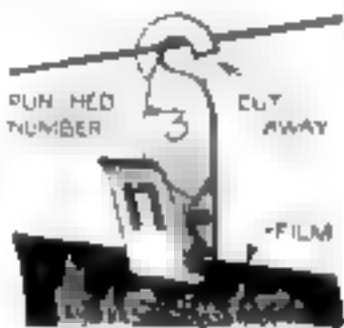
works very well and is easy to make. The toe straps are fastened at the sides with long brass screws with round heads and copper washers under the heads, or they may be passed through slots cut through the wood. The heel straps are riveted to the toe straps with copper rivets.

A pole can be made of either spruce or hard wood; spruce is lighter and strong enough. It may be from 1¼ to 1½ in. in diameter, and of a length to suit the user. A good length is about 6 ft. The usual ring may be made from a large, heavy brass curtain ring, attached to the staff by four leather strips. Wet the leather, pass it around the ring, and rivet it so that it will hug the ring as tightly as possible. Bind the other ends of the strips to the staff with fish-line or the like. When the leather is dry, it will shrink and hold hard on the ring. Then give it a good soaking with neat's-foot oil.

Drive a brass ferrule into the other end of the staff, and put in a long, heavy wood screw to the full depth of the threads. Cut off the head and file the shank to a point.

Cheap Photo Film Clips

EXCEL- LENT clips for photo film can be made cheaply from ordinary brass shower hangers. About half the loop of each hanger is cut out, as shown,



with a pair of scissors. These hangers may be used to suspend films in the tank for development, in the fixing bath, in the washing tank, and finally on the line for drying. If desired, the hangers can be numbered with steel stamps, so that the films can be readily identified.—J. A. M.

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The Shipshape Home

(Continued from page 134)

The other designations are for the degree of coarseness of the teeth "rough," "coarse," "bastard," "second cut," "smooth," and "dead smooth." The coarse and bastard cuts are used upon rough and heavy work; the second cuts and smooth cuts are used for finer work and for finishing work that has been roughed down by coarser files. The very rough and dead smooth are seldom used.

A file that has one of its edges or sides smooth is called a "safe edge file" and is used in filing in corners where only one side of the corner is being worked.

Files are cutting tools. They should never be thrown into a drawer or be allowed to come in contact with each other or any hardened metal. Keep them in a rack at the back of the bench, each in its own hole, or in a shallow drawer, separated from each other by partitions.

Buy your handles when you buy the files and get good ones. Bore a small hole in each handle to a depth equal to the length of the tang; then counterbore this hole halfway in with a drill or bit of a diameter equal to the thickness of the tang about three quarters up from its point. Drive in the file tang by means of a block of wood held on the file end and struck with a hammer. Never strike a file with anything hard if you value your face.

When buying files and handles, get what is called a "file card," a sort of brush with stiff wire bristles, used for cleaning the files.

Don't allow your files to rust or rub together. Files are the most abused tools in the world and yet among the most useful. You can't get along without files, and they cost money, so take good care of them.—HENRY B. LARABY.

Fixing Shade Rollers

"Live" end roller, as shown, and work it under and around the latches. Talcum powder or ordinary toilet powder is made from soapstone and is a dry lubricant. It is advisable not to use oil, which will collect dust and in time make matters worse.—E. W. CURNELL, Adrian, Mich.

When a window-shade roller refuses to hold, dust some talcum powder on the



Removing Varnish

In removing old varnish from floors and other woodwork with varnish remover, the work may be speeded up and lightened by using an ordinary squeegee, such as is used by window washers, instead of steel wool or a scraper. If the varnish remover is applied generously, almost all of the old varnish may be removed in this way by going over the floor once. The squeegee is used as in cleaning a window.

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A full and complete booklet on Patents, Designs, Trade-Marks, Foreign Patents, Copyrights, Labels and Patent Office Practice with an explanation about our methods, terms, etc.

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The MONTHLY MAGAZINE with a special appeal to every man of inventive genius. Recent rulings of the Patent Office, descriptions of the latest patented inventions, legislation and court decisions affecting patents, are noted in this authoritative publication.

MUNN & COMPANY

Patent Attorneys

683 Woolworth Building, New York City

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801-D, Tower Building, Chicago, Ill.

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"I have averaged \$7000 Per Year for Three Years—Have Made Over \$90 PROFIT in One Day"

That is the statement of Frank DePrie, one of our live-wire representatives. Location of Mississippi made \$5.2 on his first sale. Victims of Alabama made \$118 in one week. Cannot quit a \$0,000 job to come with us.



DePRIE

**Ford
Auto
FREE!**

We have a plan whereby our active workers can get a Ford without cost, in addition to their big cash earnings. (Get the plan—quick!)

AGENTS WANTED

We need more men like them, because the demand for our Super Fyr-Fyter is growing by leaps and bounds. Pails to paragon, pinups, factories, schools, homes, clubs, auto owners. Approved by the Underwriters. If you are willing to work and ambitious to make some real money, get our plan. You need no experience, no tie ups, without cost for the work. No great capital required. Good territory going fast. Better write us at once.

THE FYR-FYTER COMPANY

1714 Fyr-Fyter Bldg.

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WINDOW SIGNS



AGENTS 500% PROFIT

Genuine Gold Leaf Letters

GUARANTEED TO NEVER TARNISH

For Store Fronts, Office Windows, Bank Windows, Office Doors, Panels, Board Signs, Trucks, Automobiles and Glass Signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start without previous experience. All you have to do is to know your samples. The letters are very attractive and easy to sell. Letters costing 35¢ sell for 25¢. One agent says: "Your letters are the best thing I have seen in years. I have made \$125.00 the first week and still going strong." Paul Clark says: "Smallest day \$28.70." H. Gelder made \$835.00 in six weeks.

\$60 to \$200 a Week

GENERAL AGENTS

It is easy to appoint sub-agents for this line. We pay you 75% each commission on all orders we receive from sub-agents appointed by you. We allow you 50% discount on your own orders. You can sell to nearly every trade in town all over the country as a place. Large demand for window lettering everywhere. Write today for free sample full particulars and liberal offer to general agents.

METALLIC LETTER CO., 433-A N. Clark St., CHICAGO

Print Your Own
CARDS. - QUOTE IN AD. - MAKE PROGS.

EXCELSIOR THE PRESS CO. D-33 Menden, Cal.

Sell Shirts

Dr. Medicine "Better Made" Shirts, Ties, Socks and Nightgowns. Direct from our factory to you. No middlemen. No advertising. No cost to you. Large steady income. Write for FREE SAMPLES. MADISON SHIRT CO., 608 Broadway, N.Y. City.

MURDOCK HEADPHONES



These new low prices make Murdock Headphones a more wonderful value than ever. Standard for over 19 years. Satisfactory service always. Get a pair from your dealer.

A New MURDOCK Product
MULTIPLE PHONE PLUG JACK \$1
(Cord Tip Type)
Enables you to have 4 pairs of headphones connected at once. GET ONE.

AT ALL DEALERS
WM. J. MURDOCK CO.
345 Washington Ave., Chicago, Ill.
Sales Offices, Chicago and San Francisco.

Warren Radio Loop
Get Away to Now Construction.

Free Your Set From INTERFERENCE

The 1. S. Warren Radio Loop can be used to obtain absolutely perfect reception of radio signals without any interference from other sets. It is a simple, easy to use device that can be used on any set. It is a must for every radio owner. Write for FREE SAMPLES. WARREN RADIO MFG. CO., Dept. O, Ashbury Park, N. J.

A TYPE FOR EVERY SET	
Type-A-727	30-700 cycles of radio signals - \$1.00
Type-A-728	10-700 cycles of radio signals - \$1.25
Type-A-729	10-700 cycles of radio signals - \$1.50
Type-A-730	10-700 cycles of radio signals - \$1.75
Type-A-731	10-700 cycles of radio signals - \$2.00

Is There a Polar Paradise?

(Continued from page 31)

It is no speculation of wild improbability to picture a polar paradise like some titan emerald in its alabaster setting. At Disco, Greenland, orchids warmed by natural hot springs blossom out of doors through the bitter sunless winter months!

Weighing carefully all the facts available, we may set the area of the new land at about 50,000 square miles, or roughly the size of the state of Pennsylvania. Its perimeter is bulwarked by a quake-distorted range of mountains buried in eternal ice and snow, and rearing 10,000 feet into the sky. Twisting fiords penetrate the ragged ice-gnarled coast.

Just inside the mountains hangs a veil of fog, the vapor of contrasting temperatures. For here we may imagine the aspect changes sharply. Heat from a nether world defies the cold. Whiffs of snow and ice shades swiftly to the green of verdant pastures, and gold of wooded uplands.

We come upon a level clearing on which are spread symmetrically half a hundred human habitations. Tall men magnificently built and clad in short and brightly-hued loosely fitting blouses are moving leisurely about. Mingling with them are comely, fair-haired women in dainty smocks. Laughing children dash here and there among the shrubbery.

No savages are these descendants of the vanished colony. Indeed, we shall be mistaken if they are not far in advance of our own snug selves in culture, learning, deportment, and social refinement. They have harnessed natural energy to an amazing degree. They know the truths of other worlds. They have mastered the secrets of health.

May Revolutionize Commerce

Yet we need not be swept away by too sanguine a view of what the ZR-1 may find. There are other features savoring more of cold, hard facts than of romance.

For instance, a polar air route cuts the distance to European and Asiatic capitals from 11,000 to 5000 miles. A vast volume of commerce and traffic will be deflected from America toward the Pole.

No matter what the land may be which lies close to the Pole, it will control the Polar Ocean strategically. Appreciation of this fact is evidenced by Amundsen's announcement that his next great effort to be first across will include three planes. And there are whispers that two other powers are grooming entries for the race.

Alaska then must come into her own. She will gather population and stand as an arctic service station to passing planes.

The ZR-1 may get away by early June. The weather then is calm; the daily temperature just above the freezing point. After her 6000-mile flight from Lakehurst to Point Barrow, from which she will eventually take off, there must be a period of final grooming; possibly a trial or two out over the icefields. And by the Fourth of July, 1924, we should know the answer to this most thrilling of all man's geographical conundrums.

Does a polar paradise exist? And, if so, are the vanished Norwegians there?



What are you doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. A. will prepare you for the position you want in the work you like best. Yes it will! Put it up to us to prove it! Mark and mail this coupon now!

Decorations

GLORIA LIGHT COMPANY
106 N. MAY ST. CHICAGO, ILL.

(Turn to page 141)

American Family Co.
 1 American Bldg. Newark, N.J.

American Plywood Co.
5 American Bldg., Cincinnati, O.

This One



1TRL-188-306J

How Lively Is Your "B" Battery?

THIS IS NUMBER THREE OF A SERIES

Some people buy Eveready "B" Batteries oftener than other people. This is because each fan has different tastes and desires in radio receiving. Those that demand maximum volume—and to get it use many tubes, forcing them to the limit with high voltages on the plates—are eager and frequent buyers of these batteries.

Others renew them less often. They are the ones that are content with smaller volume and employ fewer tubes at lower plate voltages.

Furthermore, every radio fan, regardless of the tubes he uses, has his own ideas as to when it is time to strengthen the signals with fresh "B" Batteries. Some will long enjoy concerts that others would not consider loud enough. Just what is "too weak" is purely a matter of personal opinion.

These, then, are the things that determine how long you use your "B" Batteries—

1. *The number and kind of tubes.* The more tubes you use and the greater their power, the more current flows from the "B" Battery and the shorter is its life.
2. *The "B" Battery voltage.* The higher it is, the more current flow, from the battery.
3. *The amount of negative grid bias ("C" Battery voltage) on amplifiers.* The greater the bias, the smaller the "B" Battery current.
4. *The life put into the battery in the first place by the manufacturer, and the freshness of the battery when you buy it.*
5. *The signal strength you wish.* The smaller the volume of sound you can enjoy, the longer you can use your "B" Batteries.

The life of any "B" Battery you can buy is affected by the above factors. Subsequent advertisements will set forth each factor in detail.

Eveready "B" Batteries predominate. There is more life in them—they last longer! Blocks of large cells, packed with energy, made especially for radio use, delivered fresh to your dealer, give you the most power for your money—power you can use loudly and swiftly, or softly and slowly, as you wish—Eveready for Everybody.

"the life of your radio"



The Metal Case Eveready "B" Battery, No. 766. The popular 22½-volt Eveready Battery in a new handsome, durable, waterproof metal case. At all dealers, \$3.00.

Eveready "B" Battery No. 767. Contains 30 large size cells, as used in the popular No. 766. Voltage, 45. Made especially for sets using detector and one or more stage of amplification. The most economical "B" Battery where 45 volts are required. At all dealers, \$5.50.



Eveready Radio Battery No. 771. The Eveready "Three." The ideal "C" Battery. Voltage, 4½ — three terminals permitting the use of 1½, 3, or 4½ volts. The correct use of this battery greatly prolongs the life of the "B" Battery. At all dealers, 70 cents.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, Inc.
Long Island City, N. Y.

EVEREADY

Radio Batteries

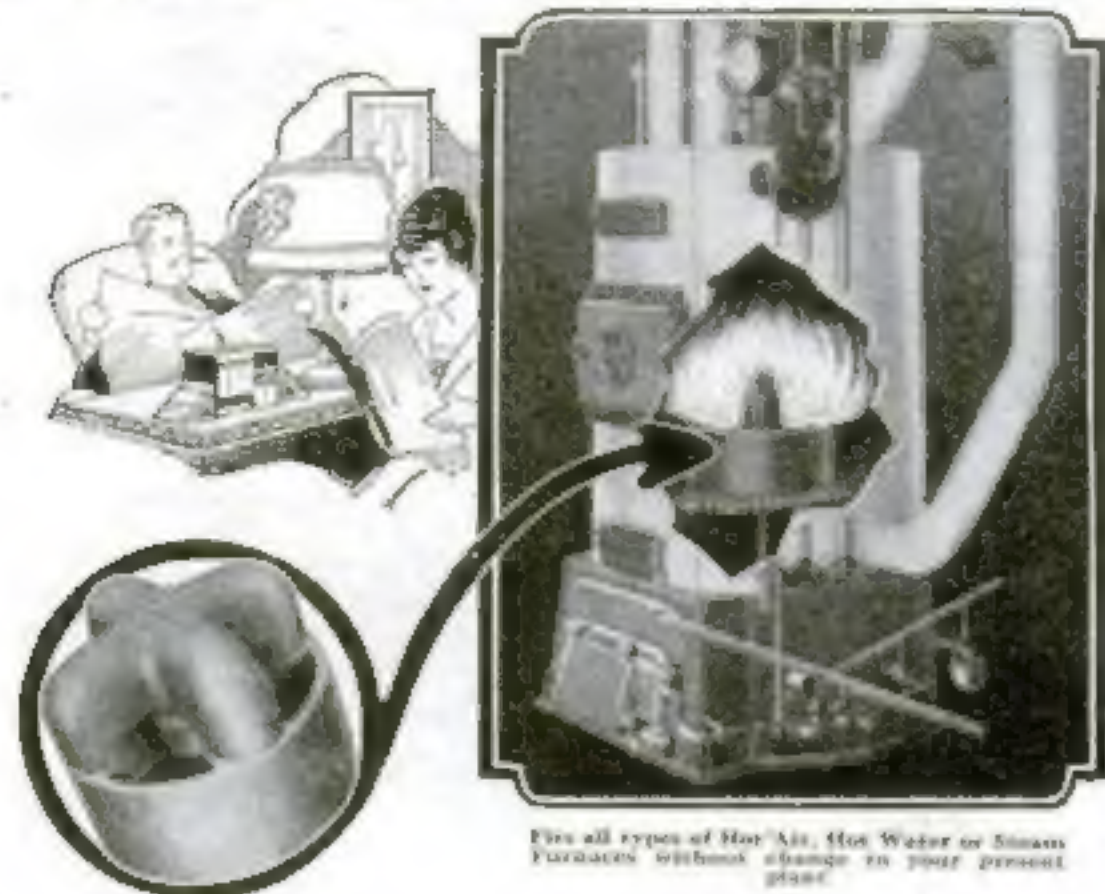
—they last longer

Note: This is Number 3 of a series of informative advertisements, printed to enable users to know how to get the most out of their receivers and batteries. If you have any battery problem, write to G. C. Furness, Manager Radio Division, National Carbon Company, Inc., 116 Thompson Ave., Long Island City, N. Y. Write for special booklets on "A," "B," and "C" Batteries.

DON'T BURN COAL!

FITS ANY FURNACE or STOVE

The Oliver burner fits all hot water, hot air or steam furnaces as well as all types of coal or wood ranges and heating stoves. Quickly and easily installed without change. No noisy motors, no electrical connections, no moving parts. This invention equips any furnace to burn a new cheap fuel called Oil-Gas. Three times the heat of coal without any of the drudgery. And so low in price that any family can afford its installation and cleanliness and comfort.



Fits all types of Hot Air, Hot Water or Steam Furnaces without change in your present plant.



New Kind of Fuel Replaces Coal In Any Furnace or Stove!

COAL—ashes—dirt—dust—soot—smoke—building fires—cleaning furnaces—carrying ashes—uneven heat—cold rooms—frozen pipes—coal shortages—poor quality—exorbitant prices? **NO!** Never again as long as you live!

INSTEAD: Quick heat—cheap heat—plentiful heat—clean heat—even heat—warm rooms—smokeless heat—sootless heat—ashless heat—odorless heat—and all this controlled by the turn of valve, or, **AUTOMATICALLY** by a thermostat, with an installation every family can afford.

Three Times the Heat of Coal

Mr. B. M. Oliver, well known heating expert, discoverer of this new method, calls his invention the Oliver Oil-Gas Burner because it uses 95% air and only 5% oil, the cheapest fuel there is. The result is a perfect fuel gas that burns with an intense, clean flame giving three times the heat of coal.

No Expensive Equipment

This simple device, without noisy mo-

tors, without electrical connections, without any moving parts—converts any type or size of steam, hot water, or hot air furnace into an automatic heating plant. Maintains a steady, even temperature in coldest Winter weather. Quickly, easily installed without any change whatever to your furnace. Absolutely safe. Lasts a Lifetime.

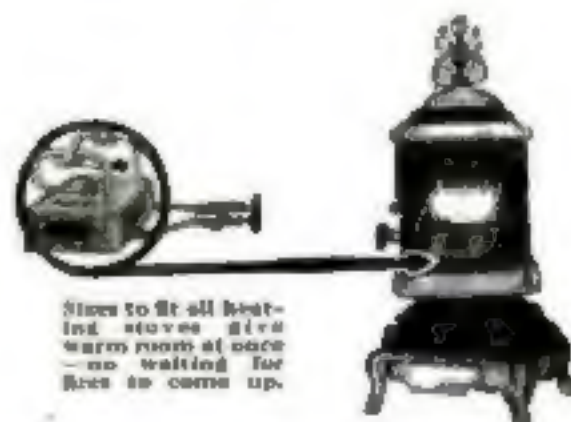
Perfect Heating Guaranteed

The performance of the new Oliver Burner has been so thoroughly tested and proved in over 150,000 homes that Mr. Oliver gives anyone the opportunity of using his invention under an extraordinary guarantee of complete satisfaction.

Low Introductory Offer

Find out now how you can be freed forever from dirt, drudgery and expense of coal fires. Tear out, fill in and mail the coupon below for full description and low price. By mailing coupon at once you will be entitled to the low introductory price offer whether you buy now or later.

The Oliver Burner makes any range a gas stove—on and off at turn of valve



Sizes to fit all heating stoves give warm room at once—no waiting for fire to come up.

AGENTS, SALESMEN and DISTRIBUTORS
Demand is enormous. Thousands of spare time workers, agents and salesmen are needed. \$75 a week easy! Many getting \$1,000 a month. Men with selling organizations who can swing whole territory can earn \$10,000 to \$50,000 or more a year. Write or wire at once for details and figures or appointment for interview. Address me personally, B. M. Oliver, at address shown.

OLIVER

OIL-GAS BURNERS

OLIVER OIL-GAS BURNER CO., 2007-L Oliver Bldg., St. Louis, Mo.
Oldest and Largest Manufacturers of Oil-Gas Burners in the World
Canadian Distributor, 2007-L Oliver Bldg., Toronto, Ontario

OLIVER OIL-GAS BURNER CO.

2007-L Oliver Building, St. Louis, Mo.

Gentlemen:—Send me your Free book "New Kind of Heat" and your Special, Low Price, Introductory Offer. I am interested in burner for a

☐ Coal Range ☐ Heating Stove ☐ (Steam) (Hot-Air) Furnace ☐ (Hot Water)

Name

Address

City State

The SIXTH SENSE OF INDUSTRY

Tycos Temperature Control

THE crisp, evenly colored crackers that are now to be had in every food store in any part of the country aren't the result of chance.

They are made by the millions—yet whenever you buy them, whether in North Dakota or in New Mexico, Connecticut or California you know they will be of the same dependable quality.

In the old days no two crackers tasted exactly alike. They were made by bakers who depended on their sense of taste. Naturally they varied in taste—and quality.

Today the sense of taste in manufacturing has been replaced by the sixth sense of industry—Tycos.

Certain temperatures, exactly regulated and accurately controlled, are required in making crackers—and all other food products that are baked, boiled, roasted or otherwise cooked before they reach the public.

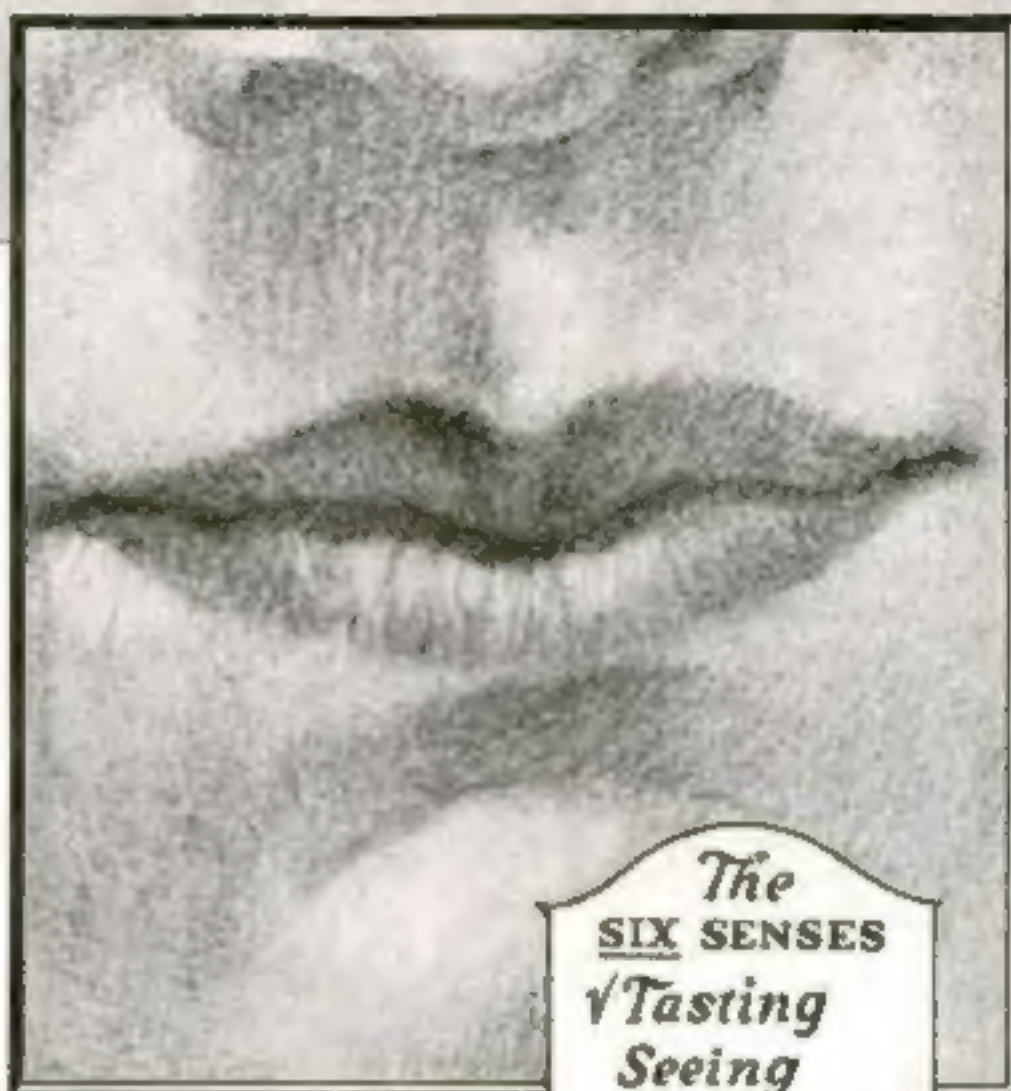
This exact regulating and control of heat required in baking is supplied by Tycos Instruments.

These instruments are more than human—they work automatically—there is no guesswork in manufacturing when they are used. Tycos Instruments ensure the uniform quality that is essential to any product that has a big sales volume.

MANUFACTURERS

What is your problem of applying the "sixth sense" to your manufacturing? For every process requiring heat control or regulating—in any industry—there is a type and style of instrument in the Tycos Line that embraces over eight thousand varieties of heat control, indicating and recording instruments.

Write us and informative literature on any instrument or type of instrument will be sent promptly. Or, if you prefer, our experts will advise you on how money can be saved in your plant by the application of Tycos Heat Control.



The
SIX SENSES
✓ Tasting
✓ Seeing
✓ Feeling
✓ Hearing
✓ Smelling
and
Tycos
Temperature
Control

Tycos in the Home

Tycos Oil Thermostat
An aid in promoting human efficiency.

Tycos Bath Thermometer
To enable you to get the most good from your bath.

Tycos Home Set
Includes: Thermostat, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometer
To help you maintain a temperature in your house conducive to good health.

Tycos Quality Comparator
To show you the right way to measure your work.

Tycos Free Thermometer
A thermometer in every home.

Tycos Thermocouple
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

TYCOS and the MEDICAL Profession

Tycos Sphygmomanometer, Pocket and Office type

Tycos Urinalysis Glassware

Tycos Fever Thermometers

Bulletins on request.

Taylor Instrument Companies

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ROCHESTER, N. Y., U. S. A.

Canadian Plant
TYCOS BUILDING
TORONTO
CANADA

Tycos Temperature Instruments



Victrola

RENEWED & PAT. OFF.



Now is the time to select your Victrola for Christmas

Victrola Instruments and Victor Records are so much in demand for gifts that there is a shortage every Christmas. Place your order now while all the twenty-one instrument styles at from \$25 up and complete record stocks are available.

Ask your dealer or write to us for illustrated catalogs.



Victrola

Look under the lid and on the labels for these Victor trade marks
Victor Talking Machine Company, Camden, N. J.